BRIEFING TO RES OFFICE DIRECTOR AND DEPUTY DIRECTOR
LEVERAGING THE USE OF LICENSEES' PRA MODELS IN LIEU OF SPAR MODELS

BRIEFERS:

Rich Correia
Louise Lund
Jeff Circle
Peter Appignani
Lauren Ning

PURPOSE:

For office staff and DRA management to inform the OD/DOD of the various items to consider:

- Proposal to adopt the use of licensees' PRA models in lieu of SPAR models for regulatory applications and reporting activities.
- Areas of consideration and challenges faced in developing an NRC pilot program to adopt one or multiple licensee models to explore its feasibility.

EXPECTED OUTCOMES:

- Provide Senior RES management with key talking points pertaining to the use of licensee PRA models for SDP and other risk-informed regulatory activities.
- OD and DOD will have an understanding of the issues influencing the office and the agency during interactions with internal and external stakeholders (e.g., the Risk-Informed Steering Committee (RISC) meetings).

PROCESS:

- High-level summary discussion of the issues and concerns.
    - Budget and funding impacts
    - Impact on regulatory activities.
    - Internal and external stakeholders.
    - Challenges.

- Mid-level and background information is attached for convenience.

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LEVERAGING THE USE OF LICENSEES' PRA MODELS IN LIEU OF SPAR MODELS

Probabilistic Risk Assessment Branch
Division of Risk Analysis
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission

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Industry and NRC Use of PRA Today

- Industry Use of PRAs
  - PRA is used by the industry today primarily for risk-informed licensing basis and design basis changes.
    - Applications are submitted under 10 CFR § 50.9 Completeness and accuracy of information.
  - They are also used for specific NRC programs such as *Mitigating Systems Performance Index* (*MSPI*), where NRC has examined the information and the program was piloted to ensure accuracy.
  - When appropriate, the SRAs use licensee PRAs for Notice of Enforcement Discretion (NOEDs)

Industry and NRC Use of PRA Today

- NRC Use of PRAs (SPAR Models)
  - ROP – Reactor Oversight Process
  - SDP – Significant Determination Process
  - MD 8.3 - NRC Incident Investigation Program
  - Notice of Enforcement Discretion (NOEDs)
  - Technical basis for rulemaking
  - Generic Issues
  - Initial licensing activities (NRO)
  - ASP – Accident Sequence Precursor
  - Inspection Support and Resources
  - System and Component Studies
  - Other risk-informed related activities
    - Includes licensing activities

August 2007 NEI Commission Briefing on Risk-Informed Regulation

- Relevant Discussion Topics[1]
  - Using risk-informed approaches remains a priority for the industry
  - These methods have demonstrated improvements to both safety and operations
  - Reinforce desire to pursue improvements to the reactor oversight significance determination process
- NEI Proposals
  - use of licensee PRAs for SDP
  - focusing licensees on corrective action rather than further analysis of small risk impacts
- Lessons learned from development of an NRC-endorsed internal events PRA standard.
- Industry's near term priorities: develop internal events at power and fire PRAs meeting the technical adequacy requirements of consensus standards.
- These efforts, along with those related to addressing SDP activities, will essentially consume the existing PRA infrastructure for the next several years.
- It is not realistic to impose or achieve regulatory expectations relative to complete scope PRAs in this time frame.

1, Letter from NEI, Aug 4, 2007, Subject: August 2 Commission Briefing on Risk-Informed Regulation

Advantages Using Licensee PRA[1]

- **Advantages Licensee Performs Analysis:**
  - Will not require staff to expend additional resources to update the SPAR models.
  - Allowing licensees to use RG 1.200 compliant models for SDPs may motivate them to invest resources to advance the quality of their models.
  - A "certified" PRA (consistent with RMRF Option 2) would allow the licensees PRA to be the PRA of record for all regulatory actions—including SDP.

- **Advantages NRC Staff Uses Licensee PRA:**
  - Will not require staff to expend additional resources to update SPAR models.
  - The most up to date model will always be used.
  - May motivate licensees to develop and maintain PRA models that comply with RG 1.200.
  - Although NRC is using the licensee model, the independence is maintained.
  - The ability to assess generic and other fleet-wide issues will be maintained if NRC maintains a model of record.

1.. Use of Licensee PRA Models RISC 01272016 (NRR Brief)

Budget and funding impacts

- Perceived cost savings versus real cost
  - Initial costs to use licensee PRAs: $7.8M
    - Used re-baselining cost assumptions provided by NRR
  - Annual ongoing costs to use licensee PRAs: $2.5M
  - Current comparable FY16 SPAR model costs: $800K
    - All SPAR model related cost for FY16: $1.9M
- Minimum resources necessary to support regulatory activities.
  - SPAR model costs are scalable
- Cost to all licensees to use their models
  - unknown at this time

Key Talking Points

Letter to NEI from OEDO on Use of SPAR models (2007, ML072490566)

- This letter addressed an NEI proposal to use licensee PRA models instead of SPAR models. A detailed review was conducted and concluded that SPAR was needed to:
  - Maintain **independence** of NRC analyses. Differences between NRC and Licensee assessments is not due to the base model, but by the assumptions for each specific event or condition analysis
  - Provide **standardized model framework** for efficient analyses - industry does not use a standardized modeling approach
  - **Avoid inefficiencies** in having agency risk analysts learn the conventions of over 70 licensee developed PRAs (utilizing up to four different software platforms)

The basis for the staff conclusion remains valid today.

Key Talking Points

Feedback from Regional SRAs on Potential Use of Licensee Models vice SPAR

- More efficient and objective to use SPAR models for risk assessments.
- It would take a significant increase in resources to use licensee models for event and condition assessment activities due to their lack of standardization and need for SRAs to understand unique modeling conventions and new code platforms.
- Use of licensee models would cause delays in the SDP process due to need to engage in additional requests for information to understand licensee PRA modeling assumptions.
- NRC's ability to perform independent regulatory assessment activities will be eroded by not having a centralized system evaluating Generic Safety Issues.

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Impact on Regulatory Activities

- Actual process is unknown at this time
  - Will NRC staff use licensee PRA?
  - Will licensee perform the analysis using their PRA model?
- Efficiency of model usage – standardization of modeling conventions, naming schemes and post processing rule construction; reporting functions; consistency in event tree/fault tree construction; single software platform.
- Development of Plant Information Risk eBooks (PRIBS) – SPAR/SAPHIRE have enhanced capabilities to generate PRIB inputs in an automated fashion, development of similar capability for licensee models needs to be explored. PRIBs replaced NRRs SDP notebooks.
- Availability of help desk support for modeling questions and technical assistance for Event and Condition Assessment modeling changes.
- Conflict of interest issues with use of licensee generated model for regulatory decision-making (will need to engage OGC for concurrence).

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Impact on Regulatory Activities

- Training costs associated with bringing staff up to speed on CAFTA, and other PRA codes currently in use.
- Availability of PRA models and supporting documentation – will they be formally submitted to NRC? Under oath and affirmation? Subject to 10 CFR 50.9? Will all licensees voluntarily submit their models?
- Updating process for licensee models - how to manage and control? How will staff ensure we have the latest model?
- Technical adequacy of SPAR models for certain modeling aspects important to event and condition assessments may be more advanced than licensee models such as LOOP modeling, common cause failure modeling and support system initiators.
- Use of licensee models to support system and component studies (SPAR/SAPHIRE currently have capabilities to efficiently run multiple cases to perform sensitivity studies and derive risk insights across multiple models).

Impact on Regulatory Activities

- Risk analyses using a SPAR model or a licensee PRA model are often in close agreement when performing an SDP. Differences in SDP outcomes between the NRC and the licensee are driven by factors other than the baseline PRA model, typically engineering assumptions, modeling assumptions, human reliability assumptions or application of common cause.
- Although licensees have made progress in developing RG 1.200 compliant PRA models, these models lack the standardization and ROP-specific features that are essential to the agency's needs for performing event and condition analyses.

Internal and external stakeholders

- Public
  - Use of licensee PRA or licensee performing analysis could erode public confidence
  - In effect the licensee is communicating events and degraded plant conditions to the public and other stakeholders if they perform the analysis
- NRR
  - ROP – Reactor Oversight Process
  - SDP – Significant Determination Process
  - MD 8.3 - NRC Incident Investigation Program
  - Notice of Enforcement Discretion (NOEDs)
  - Technical basis for rulemaking
  - Generic issues
  - Other risk-informed licensing related activities
- NRO
  - Initial licensing activities today
  - Same as NRR in the future

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Internal and external stakeholders

- Regions
  - ROP – Reactor Oversight Process
  - SDP – Significant Determination Process
  - MD 8.3 - NRC Incident Investigation Program
  - Notice of Enforcement Discretion (NOEDs)
- RES
  - ASP – Accident Sequence Precursor
  - Technical basis for rulemaking
  - Generic issues
  - Inspection Support
  - Other risk-informed licensing related activities
- Licensees
- NEI
- Owners Groups
- NGOs
- Others

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Challenges

- Erosion of Public confidence (Openness)
- Cost
- Impact on Regulatory Activities (Reliability)
- Loss of efficiency (Efficiency)
- Staff learning curve (Clarity)
- Model updates (Reliability/Clarity)
- Logistics and technical support (Independence)
- Licensee cooperation (Independence)

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Questions?

NRC's Principles of Good Regulation
Independence, Openness, Efficiency, Clarity, and Reliability

Current SPAR Model Costs	
	Per year costs
Base Resources (i.e., minimum requirements for the program):	
· SPAR Model Configuration/Quality Control and User Support Help Desk ~$500k/year	$500,000
− Help desk handles ~ 2 calls/day from SRAs	
− Ensures model version control and maintains INL Website	
− Performs model updates to support specific SDP/ASP activities (~30 models were updated to support a specific analysis in FY2015). These updates are often highly specific to the event/condition that occurred and would also need to be performed for a licensee PRA model	
· SAPHIRE QA and User Support ~$300k/year	$300,000
− Maintain NUREG/BR-0167 QA program	
− User help desk Support	
SUBTOTAL	$800,000
Resources needed to Support Specific User Enhancements:	
· Model Updates to Reflect Significant Plant Changes (~12 models/year) - ~$250k	$250,000
− Incorporate station blackout EDGs	
− Battery charging generators	
− Significant model upgrades	
· External Hazard and Fire Models - ~ $400k/year	$400,000
− Add NFPA 805 fire modeling	
− Add seismic and high wind model capabilities	
· SAPHIRE Enhancements ~$300k /year	$300,000
− New reporting features and code capabilities	
· Data Updates (performed every 3 years) - ~$500k (every three years)	$166,667
− Upgrade SPAR models to reflect most recent operating data	
− Update model documentation and Plant Risk Information eBooks (PRIBs)	
− General model cleanup/improvements	
SUBTOTAL	$1,116,667
TOTAL	$1,916,667

Cost Estimate Using Licensee Models
Cost Estimate Based on NRR Rebaselining Budget Values

Activities	Initial Costs (dollars)	Initial costs in FTE	Ongoing Annual costs in $	Ongoing Annual costs in FTE
1.Review Licensee PRAs (assumes 80 different PRAs) - A typical Level 1 industry peer review takes approximately 75 person/days (5 people for about 3 weeks)	$5,621,918	32.88		
Staff will need to gain an in-depth understanding of each unique model, including				
• Modeling assumptions				
• Modeling conventions				
• Naming schemes (basic events, fault trees, event tress, etc.)				
• Post processing rule construction				
• Other …				
Note: loss of standardization may require additional SRAs - cost not included				
Review updated/revised PRAs (assume 10%/year)			$562,192	3.29
2. Coordinate logistics with industry and staff (assumes 4 FTE initially, then 2 FTE ongoing)	$974,466	5.70	$487,233	2.85
Receive and process submittal (assumes the models will be proprietary)				
Create and manage reference library (assumes both digital and hardcopy)				
Coordinate review of revised PRA				
Duplicate and distribute models and software				
Industry User Groups (software, others)				
Provide limited Technical Support to SRAs				
3. RASP Handbook Revisions- Provides for uniformity of assessments - based on the Standardized SPAR Models	$730,849	4.27	$365,425	2.14
Assumes 3 FTE for initial major revision and 1.5 FTE for at least the first few years				
4. Software Licensee's				
CAFTA (EPRI) - includes FTREX, actual current cost	$10,000		$10,000	
WinNUPRA (Scientech) - estimated	$10,000		$10,000	
Riskman (ABS Consulting) - estimated	$10,000		$10,000	
RiskSpectrum (Lloyd´s Register Consulting, Sweden) - estimated (may not be needed)	$10,000		$10,000	
		0.23		0.23
5. Training on new software (initial training assume 5 days each for 25 staff)				
CAFTA (EPRI)	$117,123	0.68	$23,425	0.14
WinNUPRA (Scientech)	$117,123	0.68	$23,425	0.14
Riskman (ABS Consulting)	$117,123	0.68	$23,425	0.14
RiskSpectrum (Lloyd´s Register Consulting, Sweden) (may not be needed)	$117,123	0.68	$23,425	0.14
6. Loss of SAPHIRE reporting features and other automation tools (assume 36 in-depth SDPs/year)			$168,658	0.99
Additional time required to perform and document each analyses (assumes 40 extra hours per evaluation)				
Includes offline computation reviews				
7. Technical support - similar to current support provided by INL ** Too many unknowns to estimate --- Currently spending about $500k/year			***$500,000***	
8. Support MD 8.3 - NRC Incident Investigation Program, Notice of Enforcement Discretion (NOEDs), technical basis for rulemaking, generic issues and other risk-informed licensing related activities (estimated 1.5 FTE)			$255,800	1.50
TOTAL assuming no additional SRAs	**$7,835,726**	**45.82**	**$2,473,005**	**14.46**
	Assumptions;			
	$117.12	per hour		
	1460 hours = 1 FTE			
	From NRR Rebaselining assumptions			
	1 FTE =	$171,000		

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Key Talking Points for the Standardized Plant Analysis Risk (SPAR) Model Program

- Program provides **independent** risk analysis capability for NRC in support of reactor oversight process (ROP) and a variety of risk-informed technical applications
- Plant-specific SPAR models (99 operating plants are represented by 75 SPAR models) use **standardized** modeling and naming conventions. Standardization increases analyst efficiency and accuracy and supports cross comparison across models.
- SPAR models and the SAPHIRE PRA code are **designed to support event and condition analyses** by performing "delta-risk" analyses (e.g., change in CDF from base case to performance deficiency). Licensee developed models and supporting codes lack this capability (requiring additional calculations and manual sequence/cutset result comparisons)
- The program leverages available licensee PRA information to reduce program costs, but includes validation of licensee modeling assumptions and integrates licensee model conventions into standardized SPAR modeling framework. Although SPAR models use some simplifying assumptions compared to licensee models, in several areas most pertinent to ROP applications, the SPAR models are generally more detailed (e.g., CCF, LOOP, and support system initiators)
- All models run on a single code platform (SAPHIRE). SAPHIRE can be updated and configured to directly support NRC risk assessment activities through coding changes and customized reporting functions. Use of licensee models would require the NRC to maintain licensees and network environmental approval for multiple commercial software codes and eliminate the ability to revise these code to support NRC-specific applications.
- Although licensees have made progress in developing RG 1.200 compliant PRA models, these models lack the standardization and ROP-specific features that are essential to the agency's needs for performing event and condition analyses.

SPAR Model Uses

- Significance Determination Process (Reactor Oversight) - **Regions**
- Accident Sequence Precursor Program (used as an input metric to the performance budget process) - **RES**
- Evaluation of Notices of Enforcement Discretion – **Regions**, **NRR ***
- MD 8.3 Incident Investigation Program Risk Evolutions (e.g., determine level of inspection response to an event) – **Regions ***
- Establish technical basis for rulemaking – **RES, NRR**
- Evaluate generic issue safety significance - **RES**
- Perform system and component studies - **RES**
- Inspection Planning (e.g., risk insights from Plant Risk Information eBooks) - **Regions**

**** These applications typically are performed with limited time, highlighting the importance of model standardization for SPAR***

SPAR Model Annual Budget

The SPAR/SAPHIRE annual budget for **FY2015 was ~$2.2 million**. This amount is scalable depending on agency needs and available resources. Major activities include:

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Base Resources (i.e., minimum requirements for the program):

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  - Help desk handles ~ 2 calls/day from SRAs
  - Ensures model version control and maintains INL Website
  - Performs model updates to support specific SDP/ASP activities (~30 models were updated to support a specific analysis in FY2015). These updates are often highly specific to the event/condition that occurred and would also need to be performed for a licensee PRA model

- SAPHIRE QA and User Support ~$300k/year
  - Maintain NUREG/BR-0167 QA program
  - User help desk Support

Resources needed to Support Specific User Enhancements:

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  - Incorporate station blackout EDGs
  - Battery charging generators
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- External Hazard and Fire Models - ~ $400k/year
  - Add NFPA 805 fire modeling
  - Add seismic and high wind model capabilities

- SAPHIRE Enhancements ~$300k /year
  - New reporting features and code capabilities

- Data Updates (performed every 3 years) - ~$500k (every three years)
  - Upgrade SPAR models to reflect most recent operating data
  - Update model documentation and Plant Risk Information eBooks (PRIBs)
  - General model cleanup/improvements

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This letter addressed an NEI proposal to use licensee PRA models instead of SPAR models. A detailed review was conducted and concluded that SPAR was needed to:

- Maintain **independence** of NRC analyses. Differences between NRC and Licensee assessments is not due to the base model, but by the assumptions for each specific event or condition analysis
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October 15, 2007

Mr. Marvin S. Fertel, Senior Vice-President
and Chief Nuclear Officer
Nuclear Energy Institute
1776 I Street, NW, Suite 400
Washington, D.C. 20006-3708

Dear Mr. Fertel:

On behalf of the U.S. Nuclear Regulatory Commission (NRC), I wish to thank you and the industry representatives who took the time to brief the Commission on August 2, 2007, regarding risk-informed, performance-based regulation. We would like to respond to some of the discussion areas presented during your visit and in your follow-up letter of August 14, 2007, to Chairman Klein.

In your letter, you stated that essentially all plants have probabilistic risk assessment (PRA) models that are of comparable technical adequacy to those plants represented at the briefing. The staff understands that all plant PRA models have undergone a peer review based on the guidance provided by the owners' groups or by the Nuclear Energy Institute (NEI) in NEI 00-02. These peer reviews have resulted in a number of open items that a licensee would need to resolve to ensure high quality and consistency of the PRAs. The staff believes that not all significant open items have been resolved. By completing the ongoing efforts to address the results of the peer review and Regulatory Guide 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," the industry will be able to assure consistency of technical quality required for risk-informed methods for regulatory applications. We strongly encourage industry to continue with these efforts.

You also addressed in your letter opportunities for improving the significance determination process (SDP), and included example proposals on the use of the licensee's PRAs. The staff, together with NEI, industry representatives, and other stakeholders, have held a series of public meetings to discuss these proposals. The results of the staff's review of these proposals are discussed in the enclosure. The staff has concluded that the continued use of the NRC's standardized plant analysis risk (SPAR) model is, at present, the appropriate mechanism to evaluate the risk significance of findings in the SDP. The staff is willing to discuss any concerns you have with the adequacy of the SPAR models and any additional process improvements to the reactor oversight process.

Finally, as described in your letter, we agree that further development of full-scope PRAs that are consistent with an integrated standard is a meaningful goal. The development and NRC endorsement of PRA quality standards for low power and shutdown operations, accident progression analysis, and offsite consequence analysis are long term objectives. Given the time period necessary for development and endorsement of the standards, conducting pilot applications, and updating licensee PRAs, we encourage the continued participation of the industry in the timely development of these standards so that we can meet these objectives.

We look forward to working with the industry and the public as we continue to develop and refine risk-informed regulations and a standardized application of risk assessment models to further the agency's mission of maintaining public safety.

Sincerely,

/RA/

Luis A. Reyes
Executive Director
for Operations

Enclosure:
Significance Determination
Process Evaluation

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/RA/

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for Operations

Enclosure:
Significance Determination
Process Evaluation

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Significance Determination Process Evaluation

The August 14, 2007, letter from the Nuclear Energy Institute (NEI) noted an industry proposal to use industry probabilistic risk assessment (PRA) analyses for assessing the significance of findings in lieu of the Nuclear Regulatory Commission (NRC) risk assessment tools. The NRC has reviewed the industry proposal and the results of this review are discussed below.

In considering the use of licensees' probabilistic risk assessments (PRAs) for the significance determination process (SDP), the NRC staff, together with NEI, industry representatives, and other stakeholders, have held a series of public meetings to discuss the question of whether and how licensee PRA models that are updated to meet Regulatory Guide (RG) 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," can be factored into the SDP. A task group was formed to investigate various risk assessment options in lieu of using the standardized plant analysis risk (SPAR) models in the SDP. A number of options were developed and discussed with the industry during the public meetings. In particular, the industry recommended that licensee risk analysts assess the risk of performance deficiencies and provide the results to the NRC for review and action.

The following topic areas were discussed during the public meetings between the NRC and the licensees:

(1) Maintaining the independence of the NRC and licensees' models.

The NRC staff has concluded that, because the NRC's Reactor Oversight Process (ROP) is intended to provide an independent regulatory assessment of licensee performance, it would be inappropriate for licensee risk analysts to take the lead in assessing the significance of performance deficiencies at their site. Such an arrangement would also minimize the NRC staff's ability to ensure that issues are assessed in a timely manner. Maintaining the NRC's independent oversight of licensee performance is critical for effective NRC oversight and is an important aspect of upholding public confidence in the process.

(2) The nature of the differences in the SDP outcomes using NRC versus licensee assessment methodologies.

Many insights were shared and conclusions reached by these meetings. In summary, it was noted that differences in SDP outcomes between the NRC and the licensee are driven by factors other than the baseline PRA model used for the analysis; in fact, the PRA models are often in close agreement. The differences, however, are seen in the way engineering assumptions, human reliability analysis, and recovery are handled within the analysis. We recognize that licensees may have unique perspectives on the event or condition under agency review. Therefore, the SDP allows for input from licensees regarding such risk insights and we intend to encourage further engagement with the licensees on SDP findings.

(3) Standardization of modeling and assessment techniques used.

At present, the industry has not uniformly implemented a standardized approach to performing risk analysis that would ensure uniform application across the spectrum of industry PRA models. In this regard, the NRC's use of the SPAR models, together with the ongoing development of guidance on conducting Phase 3 risk assessments, commonly referred to as the risk assessment standardization project (RASP), ensures greater uniformity in the agency's regulatory assessments. To aid licensees, we intend to make the RASP manual publicly available in the near future.

(4) Potential use by the NRC staff of licensees' PRA models.

We also considered an alternative to the current NRC staff use of SPAR models where the staff would be provided with the licensee PRA models. Under this option, the staff would perform the assessment of risk significance using the licensee model. We have concluded that the logistical and resource needs to maintain the 70-plus industry PRA models on some four software platforms would require the diversion of NRC staff efforts and the addition of risk analysts. These NRC resources would be more effectively used for other tasks. At present, this alternative is not a viable option unless the industry implemented a single RG 1.200 compliant modeling approach on one analysis platform facilitating efficient use of NRC resources.

We believe that continued improvement to the standardization of PRA modeling methods in SPAR and industry PRA models is the most effective use of resources, commensurate with the need for the staff to maintain its own methods for confirmatory and independent analysis.

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Background Information

1. SPAR Level 1 Model Development.pptx
2. Relevant Inspection Manual Chapters
3. Use of Licensee PRA Models RISC 01272016
4. Letter from Don Dube (RES/DRA) to Michael D. Tschiltz, Deputy Director, NRR/DRA, Feb 28, 2007, Subject: Public Meeting Summary Regarding Use Of Standardized Plant Analysis Risk Models and Licensee Probabilistic Risk Assessment Models In The Reactor Oversight Process Held On February 22, 2007, ML070640567
5. Letter from J. E. Dyer, Director NRR, to NEI, July 2007, ML071990509
6. Letter from NEI, Aug 4, 2007, Subject: August 2 Commission Briefing on Risk-Informed Regulation
7. Letter from NEI, Dec 19, 2013, Subject: Subject: Industry Support and Use of PRA and Risk-Informed Regulation
8. NEI, Proposal for use of Licensee PRA Models in the Significance Determination Process, April, 2014
9. SPAR Model Philosophy Rev. 1.pptx
10. Outline Considerations for using other than the Standardized Plant Analysis Risk (SPAR) models

BRIEFING TO RES OFFICE DIRECTOR AND DEPUTY DIRECTOR

LEVERAGING THE USE OF LICENSEES' PRA MODELS IN LIEU OF SPAR MODELS

BRIEFING TO RES OFFICE DIRECTOR AND DEPUTY DIRECTOR

LEVERAGING THE USE OF LICENSEES' PRA MODELS IN LIEU OF SPAR MODELS

SPAR Level 1 Model Development.pptx

SPAR Level 1 Model Development

- Feedback from ~50 ASP analyses per year
- Feedback from emergent SDP analyses
- Peer reviews from licensees (ASP/SDP analyses; MSPI reviews)
- Incorporation of information gathered during SDP
- Feedback to other models through use of standardized assumptions and methods
- Identification and resolution of generic industry modeling issues
- Resolution of Peer Review Comments

Rev. 1 Models
1995 – 1998

- Developed from "Daily Events Manual"
- Train level system modeling
- Limited number of event trees

Rev. 2/2QA Models
1998 - 2001

- Expanded modeling of event trees and front line systems based on NRC reviewed IPEs
- Detailed external review by SNL

Rev. 3i Models
Completed 11/02

- Expanded number of event trees
- Support system fault trees/initiators added
- SDP plant visit comments incorporated

Rev. 3 Models
Completed 12/04

- Detailed reviews (see review guideline, 3/14/05)
- Data updated and templates generated
- RCP seal LOCA and LOOP models updated

Rev. 3.x Models
Completed 12/09

- Detailed cut set level review against PRAs (see Rev 3P Review Process Guideline, 2/21/06)
- Model documentation expanded/updated

Rev. 8.x Models
Completed 2015
Additional Success Criteria enhancements in progress

- SAPHIRE version 8 enhancements
- SSIE Models (RES/EPRI MOU)
- Expanded LOOP/SBO models (RES/EPRI MOU)
- Resolve Peer Review Comments – phase 1
- Success Criteria Enhancements

BRIEFING TO RES OFFICE DIRECTOR AND DEPUTY DIRECTOR
LEVERAGING THE USE OF LICENSEES' PRA MODELS IN LIEU OF SPAR MODELS

Relevant Inspection Manual Chapters

Relevant Inspection Manual Chapters

IMC 0306 Planning, Tracking and Reporting of the Reactor Oversight Process (ROP) 12/23/15 15-032 .docx

IMC 0307 Reactor Oversight Process Self-Assessment Program 11/23/15 15-025 .docx

IMC 0307 App A Reactor Oversight Process Self-Assessment Metrics 11/23/15 15-025 .docx

IMC 0307 App B Reactor Oversight Process Baseline Inspection Procedure Reviews 11/23/15 15-025 .docx

IMC 0308 Reactor Oversight Process Basis Document 09/04/14 14-020 .docx

IMC 0308 Att 1 Technical Basis for Performance Indicators 11/08/07 07-035 .doc

IMC 0308 Att 2 Technical Basis for Inspection Program 10/16/06 06-027 .doc

IMC 0308 Att 3 Significance Determination Process Basis Document 10/16/06 06-027 .doc

IMC 0308 Att 3, App A Technical Basis for the At-Power Significance Determination Process (SDP) 06/19/12 12-010 .doc

IMC 0308 Att 3, App B Technical Basis for Emergency Preparedness Significance Determination Process 12/19/12 12-029 .docx

IMC 0308 Att 3, App C Technical Basis for Occupational Radiation Safety Significance Determination Process 07/28/05 05-022 .doc

IMC 0308 Att 3, App D Technical Basis for Public Radiation Safety Significance Determination Process 06/25/04 04-020 .doc

IMC 0308 Att 3, App F Technical Basis for Fire Protection Significance Determination Process (II

IMC 0609, Appendix F) At Power Operations 02/28/05 05-007 .doc

IMC 0308 Att 3, App G Technical Basis for Shutdown Operations Significance Determination Process 02/28/05 05-007 .doc

IMC 0308 Att 3, App H Technical Basis for Containment Integrity Significance Determination Process 05/06/04 04-010 .doc

IMC 0308 Att 3, App I Technical Basis for Operator Requalification Human Performance Significance Determination Process 07/28/05 05-022 .doc

IMC 0308 Att 3, App J Technical Basis for Steam Generator Tube Integrity Findings 07/06/11 11-011 .doc

IMC 0308 Att 3, App K Technical Basis for Maintenance Risk Assessment and Risk Management SDP 05/19/05 05-014 .doc

IMC 0308 Att 3, App L Technical Basis for the B.5.b Significance Determination Process (SDP) 05/09/14 14-011 .doc

IMC 0308 Att 3, App M Technical Basis for the Significance Determination Process (SDP) Using Qualitative Criteria 06/11/14 14-012 .docx

IMC 0308 Att 4 Technical Basis for Assessment 07/28/05 05-022 .doc

IMC 0308 Att 5 Technical Basis for Enforcement 10/16/06 06-027 .doc

IMC 0309 Reactive Inspection Decision Basis for Reactors 10/28/11 11-023 .docx

IMC 0310 Aspects Within Cross Cutting Areas 12/04/14 14-029 .docx

IMC 0312 Technical Assistance for Radiation Safety Inspections at Nuclear Fuel Cycle Facilities and Materials Licensees' Sites 06/06/02 02-023 .doc

IMC 0313 Industry Trends Program 05/29/08 08-016 .doc

IMC 0320 Operating Reactor Security Assessment Program 06/13/12 12-009 .docx

IMC 0326 Operability Determinations & Functionality Assessments for Conditions Adverse to Quality or Safety 12/03/15 15-028 .docx FY2012-02 Rev 1

Relevant Inspection Manual Chapters

IMC 0330 Guidance for NRC Review of Licensee Draft Documents 07/8/96 96-015

IMC 0350 Oversight of Reactor Facilities in a Shutdown Condition Due to Significant Performance and/or Operational Concerns 12/15/06 06-035 .doc

IMC 0375 Implementation of the Reactor Oversight Process at Reactor Facilities in an Extended Shutdown Condition for Reasons Not Related to Performance 11/13/15 15-024 .docx

IMC 0410 Notices of Enforcement Discretion 03/13/13 13-009 .docx

IMC 0608 Performance Indicator Program 09/26/12 12-022 .docx

IMC 0609 Significance Determination Process 04/29/15 15-008 .docx

IMC 0609 Att 1 Significance and Enforcement Review Panel Process 04/29/15 15-008http://pbadupws.nrc.gov/docs/ML0735/ML073531868.pdf .docx

IMC 0609 Att 2 Process for Appealing NRC Characterization of Inspection Findings (SDP Appeal Process) 06/08/11 11-010 .doc

IMC 0609 Att 3 Senior Reactor Analyst Support Expectations 04/29/15 15-008 .docx

IMC 0609 Att 4 Initial Characterization of Findings 06/19/12 12-010 .doc

IMC 0609 App A The Significance Determination Process (SDP) for Findings At-Power 06/19/12 12-010 .docx

IMC 0609 App B Emergency Preparedness Significance Determination Process 09/22/15 15-017 .docx

IMC 0609 App C Occupational Radiation Safety Significance Determination Process 08/19/08 08-024 .doc

IMC 0609 App D Public Radiation Safety Significance Determination Process 02/12/08 08-007 .doc

IMC 0609 App F Fire Protection Significance Determination Process 09/20/13 13-022 .docx

IMC 0609 App F, Att 1 Attachment 1: Fire Protection Significance Determination Process Worksheet 09/20/13 13-022 .docx

IMC 0609, App F, Att 2 Attachment 2: Degradation Rating Guidance Specific to Various Fire Protection Program Elements 02/28/05 05-007 .doc

IMC 0609 App F, Att 3 Attachment 3: Guidance for Identifying Fire Growth and Damage Scenarios 02/28/05 05-007 .doc

IMC 0609 App F, Att 4 Attachment 4: Fire Ignition Source Mapping Information: Fire Frequency, Counting Instructions, Applicable Fire Severity Characteristics, and Applicable Manual Fire Suppression Curves 02/28/05 05-007 .doc

IMC 0609, App F, Att 5 Attachment 5: Characterizing Non-Simple Fire Ignition Sources 02/28/05 05-007 .doc

IMC 0609 App F, Att 6 Attachment 6: Guidance for the Identification of Targets and Their Ignition and Damage Criteria 02/28/05 05-007 .doc

IMC 0609 App F, Att 7 Attachment 7: Guidance for Fire Growth and Damage Time Analysis 02/28/05 05-007 .doc

IMC 0609 App F, Att 8 Attachment 8: Guidance for Fire Non-Suppression Probability Analysis 02/28/05 05-007 .doc

IMC 0609 App G Shutdown Operations Significance Determination Process 05/09/14 14-011 .docx

IMC 0609 App G, Att 1 Shutdown Operations Significance Determination Process Phase 1 Initial Screening and Characterization of Findings 05/09/14 14-011 .doc

IMC 0609 App G, Att 2 Phase 2 Significance Determination Process Template for PWR During Shutdown 02/28/05 05-007 .doc

IMC 0609 App G, Att 3 Phase 2 Significance Determination Process Template for BWR During Shutdown 02/28/05 05-007 .doc

Relevant Inspection Manual Chapters

IMC 0609 App H Containment Integrity Significance Determination Process 05/06/04 04-010 .doc

IMC 0609 App I Operator Requalification Human Performance Significance Determination Process [SDP] 12/06/11 11-040 .docx

IMC 0609 App J Steam Generator Tube Integrity Findings Significance Determination Process 07/06/11 11-011 .doc

IMC 0609 App K Maintenance Risk Assessment and Risk Management Significance Determination Process 05/19/05 05-014 .doc

IMC 0609 App L B.5.b Significance Determination Process 12/24/09 09-032 .doc

IMC 0609 App M Significance Determination Process Using Qualitative Criteria 04/12/12 12-005 .docx

IMC 0610 Nuclear Material Safety and Safeguards Inspection Reports 05/18/04 04-014 .doc

IMC 0612 Power Reactor Inspection Reports 01/24/13 13-003 .docx

IMC 0612 Exh 1 Standard Reactor Inspection Report Outline 02/07/14 14-005 .docx

IMC 0612 Exh 2 Inspection Report Documentation Matrix 09/04/14 14-020 .docx

IMC 0612 Exh 4 ROP Inspection Report Cover Letter Templates 09/13/13 13-021 .docx

IMC 0612 App A Acronyms Used in Inspection Manual Chapter 0612 12/04/08 08-034 .doc

IMC 0612 App B Issue Screening 09/07/12 12-020 .docx

IMC 0612 App C Guidance for Supplemental Inspection Reports 10/28/11 11-024 .docx

IMC 0612 App C Exh 1 Sample Supplemental Inspection Report for IP 95001 and IP 95002 10/28/11 11-024 .docx

IMC 0612 App D Documenting Problem Identification and Resolution Biennial Team Inspections (IP 71152) 08/13/13 13-017 .docx

IMC 0612 App E Examples of Minor Issues 08/11/09 09-020 .doc

IMC 0801 Reactor Oversight Process Feedback Program

BRIEFING TO RES OFFICE DIRECTOR AND DEPUTY DIRECTOR
LEVERAGING THE USE OF LICENSEES' PRA MODELS IN LIEU OF SPAR MODELS

Letter from Don Dube (RES/DRA) to Michael D. Tschiltz, Deputy Director, NRR/DRA, Feb 28, 2007, Subject: Public Meeting Summary Regarding Use Of Standardized Plant Analysis Risk Models and Licensee Probabilistic Risk Assessment Models In The Reactor Oversight Process Held On February 22, 2007, ML070640567

BRIEFING TO RES OFFICE DIRECTOR AND DEPUTY DIRECTOR

LEVERAGING THE USE OF LICENSEES' PRA MODELS IN LIEU OF SPAR MODELS

February 28, 2007

MEMORANDUM TO: Michael D. Tschiltz, Deputy Director
Division of Risk Assessment
Office of Nuclear Reactor Regulation

FROM: Donald A. Dube, Senior Technical Advisor ***/RA/***
Division of Risk Assessment
Office of Nuclear Reactor Regulation

SUBJECT: PUBLIC MEETING SUMMARY REGARDING USE OF STANDARDIZED PLANT ANALYSIS RISK MODELS AND LICENSEE PROBABILISTIC RISK ASSESSMENT MODELS IN THE REACTOR OVERSIGHT PROCESS HELD ON FEBRUARY 22, 2007

On February 22, 2007, a public meeting was held at the Nuclear Energy Institute (NEI) offices on 1776 I Street, Washington, DC, to discuss the use of the risk insights from standardized plant analysis risk (SPAR) models and the licensee probabilistic risk assessment (PRA) models to characterize the safety significance of inspection findings for the U.S. Nuclear Regulatory Commission (NRC) reactor oversight process (ROP). The agenda is provided as Enclosure 1, and a list of attendees is provided as Enclosure 2.

This meeting was held as follow-on to the December 13, 2006, kick-off meeting (see ADAMS Accession # ML063530303) of the industry and staff working groups. This activity stems from an action item from the public meeting of September 28, 2006 between the NRC PRA Steering Committee and industry representatives. The action from the September 28, 2006, meeting was to form a joint NRC/Industry task group to investigate various options to the use of the SPAR models in the significance determination process (SDP). The meeting of February 22nd focused on industry concerns, the status of the SPAR models, and options to the current process.

At the beginning of the meeting, NRC staff summarized the highlights of the December 13, 2006, meeting. The staff noted that the SPAR models are used in numerous applications other than SDP, including the accident sequence precursor program, incident investigation, generic issue prioritization, and independent review of license amendment submittals. As such, the staff would continue to maintain the SPAR models in the foreseeable future even if the decision were made not to rely upon them for SDP. In addition, the staff noted that there are large economies of scale with the SPAR program (e.g., methods, data), and even if SPAR models were not used for a large fraction of SDP evaluations there would be little resource savings to the staff in the near-term. There was consensus on the part of the staff and industry that the activity would be confined for the present to evaluating the use of licensee models only for the SDP.

CONTACT: Donald A. Dube, NRR/DRA
(301) 415-1483

The staff further noted that the SDP was a regulatory function, and that the staff reserved the final decision on whether to move forward with any recommendation coming from the activity. The industry noted that efforts are under way to upgrade a number of plant PRA models to conform to the requirements of Regulatory Guide (RG) 1.200, including training in March 2007. The industry further stated that should the NRC staff decide to move forward with whatever option is considered, it would be valuable to pilot the effort. The industry also provided a number of examples where they felt there were some form of deficiency in SDP evaluations using SPAR models (see Enclosure 3). The NRC staff acknowledged problems with the evaluations in several instances. The staff and industry agreed that areas to pay particular attention to include:

- human reliability analysis dependencies
- plant-specific initiator frequencies
- system success criteria
- incorporation of unique plant emergency operating procedures into the models
- use of historical individual plant examination of external events results.

The staff further acknowledged that as the industry makes major upgrades to models to meet RG 1.200, as well as to improve fire PRAs for National Fire Protection Association 805, the SPAR models could eventually lag the industry's models without adequate resources to keep the SPAR models up to date.

The staff did note recent initiatives to improve the quality of the SPAR models, including the SPAR model enhancement effort, quality assurance plan, and the use of the risk assessment standardization project handbook. The staff believes that many of the issues presented by the industry examples have been or are being addressed. The Office of Nuclear Regulatory Research (RES) provided a discussion of the status of the SPAR models, and noted the excellent agreement between SPAR models and licensee models following cut set level reviews, and after accounting for plant performance data differences (see Enclosure 4). The cut set level reviews are well underway with 41 models completed, another 20 models to be completed in 2007, and the remainder in 2008. RES staff highlighted the primary reasons for the model disparity, and noted that many of the technical issues are common not just to the SPAR models, but industry models as well. For example, the small loss of coolant accident frequencies for PWRs vary by some factor of 40 from low to high in the industry PRAs based on MSPI cross-comparisons.

The staff provided the results of General Accountability Office testimony on the ROP. Data for SDP findings for the period of 2001 through 2005 were presented (see Enclosure 5). The staff noted that the SPAR models have been used on a sizable fraction of the green findings as well as those greater than green, and that these need to be factored into the overall assessment of the performance of the SPAR models in the SDP. The NRC staff re-iterated its view that many of the examples presented by the industry during the meeting, as well as other cases, were the result of varying assumptions from the engineering analysis as to whether certain degraded conditions were actual failures, and for how long the condition existed, as opposed to major PRA modeling differences. Based on its experience from the four regions and headquarters, the staff was not entirely convinced that there has been an across-the-board problem with the use of the enhanced SPAR models for SDP.

The staff and industry reviewed and commented on a draft of the purpose of the working groups (see Enclosure 6). There was tentative agreement to re-phrase the purpose as follows:

> *To assess whether and how licensee PRA models that are updated to meet RG 1.200 can be factored in to the ROP.*

The industry and staff next outlined possible options (see Enclosure 7). Option 1 represents the status quo. Here, status quo represents the SDP as it is currently envisioned, that is, with continued enhancement of the SPAR models according to plan. It does not mean a static set of SPAR models. Options 2 through 4 present some alternatives to Option 1 for phase 3 SDP evaluations. Options 5 and 6 are with regard to phase 2 screening, with Option 6 the status quo (current plan). Option 7 was dismissed early on but is enclosed for completeness.

A set of 11 criteria was then established. Finally, each option was evaluated against how it would impact the criteria for consideration: either pro, con, neutral, or to be determined. The staff and industry reached general consensus on the pros and cons. (It is important to note that no weighting has been assigned to the criteria at this point.) No determination regarding the preferred option(s) has been made at this stage.

Actions for the industry and staff working groups include the following:

- provide comments on the objectives as drafted in Enclosure 6 by March 16
- better define the options, including the consideration of hybrid or mixed options
- begin to consider weights for the criteria.

The next meeting is tentatively planned for April 12, 2007, location to be determined.

Enclosures:
As stated

The staff and industry reviewed and commented on a draft of the purpose of the working groups (see Enclosure 6). There was tentative agreement to re-phrase the purpose as follows:

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Enclosures:
As stated

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BRIEFING TO RES OFFICE DIRECTOR AND DEPUTY DIRECTOR
LEVERAGING THE USE OF LICENSEES' PRA MODELS IN LIEU OF SPAR MODELS

Letter from J. E. Dyer, Director NRR, to NEI, July 2007, ML071990509

BRIEFING TO RES OFFICE DIRECTOR AND DEPUTY DIRECTOR

LEVERAGING THE USE OF LICENSEES' PRA MODELS IN LIEU OF SPAR MODELS

Mr. Anthony Pietrangelo, Vice President
Regulatory Affairs
Nuclear Generation Division
Nuclear Energy Institute
1776 I Street NW, Suite 400
Washington, D.C. 20006-3708

Dear Mr. Pietrangelo:

The Nuclear Regulatory Commission (NRC) staff, together with the Nuclear Energy Institute (NEI), industry representatives, and other stakeholders, have held a series of public meetings to discuss whether and how licensee probabilistic risk assessment (PRA) models that are updated to meet Regulatory Guide (RG) 1.200 can be factored into the NRC=s significance determination process (SDP). This activity stems from an action item from the public meeting of September 28, 2006, between the NRC PRA Steering Committee and industry representatives. The action from the September 28, 2006 meeting was to form task groups to investigate various options for the use of the standardized plant analysis risk (SPAR) models in the SDP.

A number of options were developed and discussed with the industry during the public meetings. In particular, the industry has recommended that licensee risk analysts should assess the risk of performance deficiencies, and provide the results to the NRC for review and action. After careful consideration of the merits of all of the options developed as part of this effort, the staff concludes that none of the options are acceptable alternatives to the current process for the SDP.

The NRC=s Reactor Oversight Process (ROP) provides an independent assessment of licensee performance as such, it would be inappropriate for licensee risk analysts to take the lead in assessing the significance of licensee performance deficiencies. The staff recognizes that baseline PRA models that have undergone peer review and conform to the requirements of RG 1.200 are of relatively high quality. In many cases, the staff has found these baseline models to be superior in detail to its own SPAR models, particularly with regard to external event modeling. Nonetheless, the staff=s experience with the SDP is that the analysis outcome is not heavily influenced by differences between a licensee=s PRA model and the NRC SPAR model. Typically these differences are recognized and accounted for.

Our experience has been that differences in SDP outcomes between the NRC and the licensee are driven by factors other than the baseline PRA model used for the analysis. For example, virtually every event or degraded condition for which a phase III risk assessment is conducted requires engineering analysis and PRA model modifications to represent the performance deficiency or equipment degradation. Key assumptions regarding the extent and duration of equipment degradation are made, and human recovery actions and/or systems not modeled in the baseline PRA are often credited. The manner in which the risk analyst addresses these issues can significantly influence the risk estimate outcome. We note that to the extent that licensees have unique perspectives on the event or condition under NRC staff evaluation, the SDP allows for input from licensees regarding such risk insights.

The staff has also concluded that allowing licensees to take the lead on risk assessments would minimize the NRC staff=s ability to ensure that issues are assessed in a timely manner.

Additionally, at present, the industry lacks a standardized approach to performing risk analysis that would ensure uniform application across the spectrum of industry PRA models. In this regard, the NRC=s use of the SPAR model together with the on-going development of guidance on conducting phase III risk assessments, commonly referred to as the risk assessment standardization process (RASP), ensures greater uniformity.

The staff also seriously considered the alternative to the current process whereby the staff would be provided with the licensee PRA models that meet RG 1.200. Under this option, the staff would perform the assessment of risk significance using a standardized approach. While this second option has merit, the staff has concluded that the logistical and resource needs to maintain the many licensee PRA models in-house is not feasible. Altogether, the 70-plus industry PRA models on some four software platforms would require significant NRC resources, including the addition of risk analysts, who might otherwise be more effectively utilized for other tasks. This alternative, while perhaps holding promise for the future as PRA software platform standardization advances, is not a viable solution for the near-term.

In summary, the staff believes that continued improvement to the standardization of PRA modeling methods in SPAR and industry PRA models is the most effective use of resources, commensurate with the need for the staff to maintain its own methods for confirmatory and independent analysis. The NRC independent oversight of licensee performance is also an important aspect of maintaining public confidence in the process.

We look forward to working with the industry to continue development of guidance for the standardized application of risk assessment models to operating event analysis.

Sincerely,

J. E. Dyer, Director
Office of Nuclear Reactor Regulation

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In summary, the staff believes that continued improvement to the standardization of PRA modeling methods in SPAR and industry PRA models is the most effective use of resources, commensurate with the need for the staff to maintain its own methods for confirmatory and independent analysis. The NRC independent oversight of licensee performance is also an important aspect of maintaining public confidence in the process.

We look forward to working with the industry to continue development of guidance for the standardized application of risk assessment models to operating event analysis.

Sincerely,

J. E. Dyer, Director
Office of Nuclear Reactor Regulation

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BRIEFING TO RES OFFICE DIRECTOR AND DEPUTY DIRECTOR

LEVERAGING THE USE OF LICENSEES' PRA MODELS IN LIEU OF SPAR MODELS

BRIEFING TO RES OFFICE DIRECTOR AND DEPUTY DIRECTOR
LEVERAGING THE USE OF LICENSEES' PRA MODELS IN LIEU OF SPAR MODELS

Letter from NEI, Aug 4, 2007, Subject: August 2 Commission Briefing on Risk-Informed Regulation

BRIEFING TO RES OFFICE DIRECTOR AND DEPUTY DIRECTOR

LEVERAGING THE USE OF LICENSEES' PRA MODELS IN LIEU OF SPAR MODELS

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FROM: DUE: 08/31/07 EDO CONTROL: G20070571
DOC DT: 08/14/07
FINAL REPLY:

Marvin S. Fertel
Nuclear Energy Institute (NEI)

TO:

Chairman Klein

FOR SIGNATURE OF : ** GRN ** CRC NO: 07-0538

Reyes, EDO

DESC:

Provide Followup to August 2 Commission Briefing on Risk-Informed Regulation - Project Number 689

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ASSIGNED TO: NRR

CONTACT: Dyer

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Date Printed: Aug 15, 2007 17:31

PAPER NUMBER:	LTR-07-0538	**LOGGING DATE:**	08/15/2007
ACTION OFFICE:	EDO		
AUTHOR:	Marvin Fertel		
AFFILIATION:	NEI		
ADDRESSEE:	CHRM Dale Klein		
SUBJECT:	Provides followup to August 2 Commission briefing on Risk-Informed Regulation - Project Number 689		
ACTION:	Appropriate		
DISTRIBUTION:	RF		
LETTER DATE:	08/14/2007		
ACKNOWLEDGED	No		
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NUCLEAR ENERGY INSTITUTE

Marvin S. Fertel
SENIOR VICE PRESIDENT AND
CHIEF NUCLEAR OFFICER

August 14, 2007

The Honorable Dale E. Klein
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: August 2 Commission Briefing on Risk-Informed Regulation

Project Number: 689

Dear Chairman Klein:

We appreciated the opportunity to brief the Commission on August 2 regarding risk-informed performance based regulation. Appropriately using risk-informed approaches remains a priority for the industry and we were encouraged by the supportive comments of the commissioners. As noted during the briefing, these methods have demonstrated improvements to both safety and operations. We would like to take this opportunity to reinforce several important discussion items from the briefing.

First, we would like to correct an apparent misunderstanding regarding the overall status of plant probabilistic risk assessments (PRA). Statements were made to the effect that only a few plants (particularly those at the briefing table) have high quality PRAs that are suitable for major regulatory applications and that most of the industry lagged behind in PRA development. This is not a reflection of industrywide PRA technical adequacy. In reality, essentially all plants have PRAs that are of comparable technical adequacy to those plants represented at the briefing and ongoing efforts to address Regulatory Guide 1.200 will further enhance model capability and documentation. All plant PRAs have been peer reviewed and the significant open items from these reviews have been addressed. Plants like those at the briefing that have chosen to pilot major regulatory applications have done so because of their willingness to provide industry leadership by engaging in the pilot approval process.

Second, we concur with the tenor of the comments by the Commission and would like to reinforce our desire to pursue improvements to the reactor oversight significance determination process (SDP). We believe the Commission expressed support for consideration of reform of this activity and we have provided several proposals (e.g., use of licensee PRAs for SDP and focusing licensees on corrective action rather than further analysis of small risk impacts) that could effectively mitigate the large drain on PRA resources currently being applied to de minimus risk evaluations at the green/white threshold of the SDP. Our intent is to enhance the efficiency and risk focus of the process, not to change the outcome. We request Commission direction to NRC staff to proceed in the near-term with industry and other stakeholders towards process revisions that would achieve these goals.

Finally, we would like to re-emphasize the lessons we have learned from the eight year development period required for an NRC-endorsed internal events PRA standard. Industry's near term priorities are to develop internal events at power and fire PRAs meeting the technical adequacy requirements of consensus standards. These efforts, along with those related to addressing SDP activities, will essentially consume the existing PRA infrastructure for the next several years. Therefore, it is not realistic to impose or achieve regulatory expectations relative to complete scope PRAs in this time frame. Full scope PRAs, and the concept of an integrated PRA standard, are meaningful long term objectives requiring further technology development, pilot application, and refinement.

Thank you again for the opportunity to brief the Commission on this subject and we look forward to demonstrating additional progress at next year's briefing. Please contact me or Tony Pietrangelo if you need further information.

Sincerely,

Marvin S. Fertel

Marvin S. Fertel

c: The Honorable Edward McGaffigan, Jr., Commissioner, NRC
The Honorable Gregory B. Jaczko, Commissioner, NRC
The Honorable Peter B. Lyons, Commissioner, NRC
Mr. Luis A. Reyes, Executive Director for Operations, NRC
Mr. William F. Kane, Deputy Executive Director for Reactor and Preparedness Programs, NRC
Mr. James E. Dyer, Director, NRC/NRR
Mr. R. William Borchardt, Director, NRC/NRO
NRC Document Control Desk

From: "FERTEL, Marvin" <msf@nei.org>
To: <chairman@nrc.gov>
Date: 08/14/2007 4:12 PM
Subject: August 2 Commission Briefing on Risk-Informed Regulation

August 14, 2007

The Honorable Dale E. Klein
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: August 2 Commission Briefing on Risk-Informed Regulation

Project Number: 689

Dear Chairman Klein:

We appreciated the opportunity to brief the Commission on August 2 regarding risk-informed performance based regulation. Appropriately using risk-informed approaches remains a priority for the industry and we were encouraged by the supportive comments of the commissioners. As noted during the briefing, these methods have demonstrated improvements to both safety and operations. We would like to take this opportunity to reinforce several important discussion items from the briefing.

First, we would like to correct an apparent misunderstanding regarding the overall status of plant probabilistic risk assessments (PRA). Statements were made to the effect that only a few plants (particularly those at the briefing table) have high quality PRAs that are suitable for major regulatory applications and that most of the industry lagged behind in PRA development. This is not a reflection of industrywide PRA technical adequacy. In reality, essentially all plants have PRAs that are of comparable technical adequacy to those plants represented at the briefing and ongoing efforts to address Regulatory Guide 1.200 will further enhance model capability and documentation. All plant PRAs have been peer reviewed and the significant open items from these reviews have been addressed. Plants like those at the briefing that have chosen to pilot major regulatory applications have done so because of their willingness to provide industry leadership by engaging in the pilot approval process.

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BRIEFING TO RES OFFICE DIRECTOR AND DEPUTY DIRECTOR

LEVERAGING THE USE OF LICENSEES' PRA MODELS IN LIEU OF SPAR MODELS

BRIEFING TO RES OFFICE DIRECTOR AND DEPUTY DIRECTOR
LEVERAGING THE USE OF LICENSEES' PRA MODELS IN LIEU OF SPAR MODELS

Letter from NEI, Dec 19, 2013, Subject: Subject: Industry Support and Use of PRA and Risk-Informed Regulation

BRIEFING TO RES OFFICE DIRECTOR AND DEPUTY DIRECTOR

LEVERAGING THE USE OF LICENSEES' PRA MODELS IN LIEU OF SPAR MODELS

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NUCLEAR ENERGY INSTITUTE

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

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

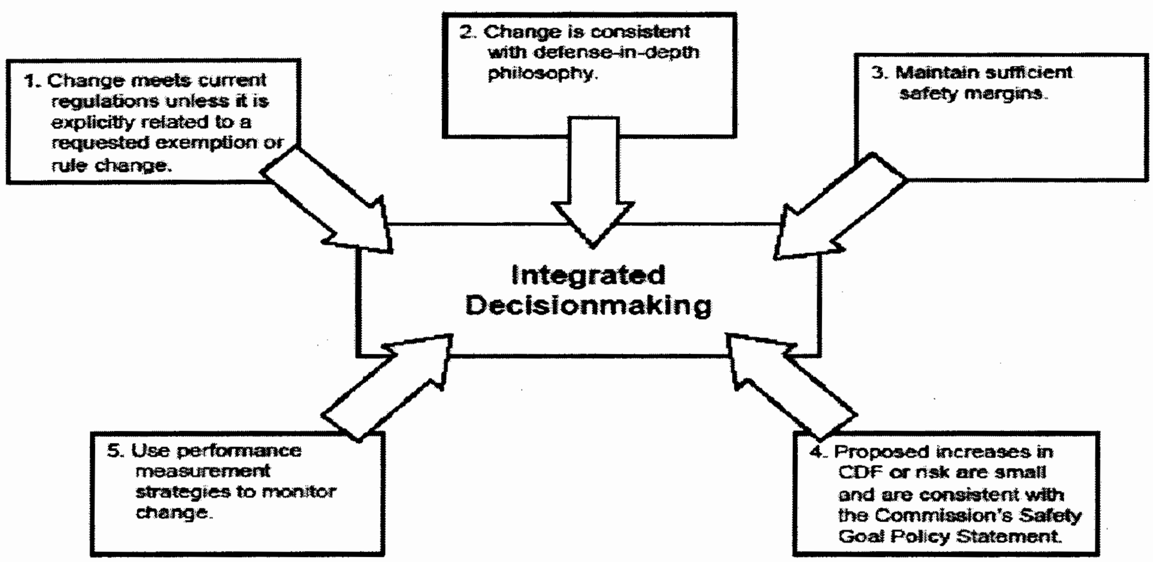
Solution Path: Restore the original approach of NRC Regulatory Guide 1.174

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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NEI, Proposal for use of Licensee PRA Models in the Significance Determination Process, April 2014

BRIEFING TO RES OFFICE DIRECTOR AND DEPUTY DIRECTOR

LEVERAGING THE USE OF LICENSEES' PRA MODELS IN LIEU OF SPAR MODELS

Proposal for use of Licensee PRA Models in the Significance Determination Process

Objective:

Initiate dialogue between NRC and industry on growing delta between site detailed PRAs and NRC SPAR Models and how they are used in the regulatory process.

Background:

Since the development of initial risk reviews by licensees in support of IPE and IPEEE, the sophistication of site-specific Probabilistic Risk Analyses has grown. There have been significant advancements in calculational methods and much greater detail in the modeling of the as-built, as-operated plant. NRC's standards for acceptability in using the plant-specific PRA's have also evolved, with most plants having assessed their models in accordance with RG 1.200, rev 2.

By contrast, the NRC SPAR model was developed as a basic tool to generate order of magnitude estimates of Core Damage Frequency (CDF), based on generic plant design. It was introduced into the ROP as a tool for assessing performance deficiencies to determine the contribution to risk (change in CDF). Though the SPAR models have also been improved, in general, they do not contain plant specific details and are still standardized (e.g., use of generic success criteria, data and exclude significant crosstie capability), yet they continue to be used as an authoritative tool for assessing risk significance.

Consequently, the difference between risk reviews performed using the SPAR model regularly diverge from those performed using the site-specific PRA, resulting in significant efforts expended by licensees to understand the differences and driving additional ad hoc changes to SPAR models to account for those existing inaccuracies. These efforts present a distraction from the intent of ROP and result in expenditure of unnecessary hours of NRC and licensee staff hours.

Site specific PRAs undergo significant internal reviews and a rigorous peer review process. Additionally, these analyses are used in the regulatory process and reviewed by NRC for risk-informed licensing actions, further adding to their credibility.

Discussion Points

- SPAR models were created several decades ago to provide a big picture perspective. Since then plant specific models have been created that are up to date and used for all plant risk informed applications
    - Modeling of human actions is conservative.
        - NRC SPAR-H is not as robust a HRA tool and results in some cliff effects.
        - Human action dependency floor value is used as an absolute value, rather than a screening value for additional review/analysis. This can lead to overly conservative results.
    - Generic nature has resulted in numerous differences that must be discovered and identified individually, typically only during SDP evaluations.
    - SPAR models are only updated every few years.
    - SPAR models are based on generic data.
    - SPAR Fire and internal flooding PRAs are bounding and very conservative.
- Plant specific PRA models have been assessed against RG 1.200.
    - Plant models are continually evaluated following plant changes to determine if the models need to be revised.
    - Plant models have plant-specific data.
    - Licensees' either have or are developing detailed Fire PRA models.
    - Licensees' typically have detailed internal flooding PRAs.
    - Site specific PRAs are the basis for MSPI and other risk-informed regulatory applications.
- Benefits of using the plant specific PRA models include:
    - Makes use of the best information available
    - Get closer to the "true" risk significance of the finding
    - Potential to reduce the amount of time to resolve the SDP and reduce the number of regulatory conferences

Recommendation:

Given that the NRC SPAR models are not as realistic as licensee models, industry recommends that the SPAR results be used as a confirmatory tool for licensee results from plant-specific PRAs in regulatory actions. A draft process for using Licensees' PRA models in the SDP process is provided below:

1. The licensee and NRC staff should benchmark the licensee and SPAR models whenever there is a revision to either model. This activity should be completed outside of an actual SPD evaluation. Benchmarking should consider:
    a. Baseline Average CDF and LERF values,
    b. Top 100 CDF and LERF cutsets,
    c. Importance Measures (RAW and F-V).
2. Significant differences should be investigated to determine the reason for the differences. Examples could be:
    a. Success Criteria,
    b. Data,
    c. Human Reliability Modeling,
    d. Modeling of Recovery Actions.
3. Significant differences in assumptions/modeling should be documented and treated as sources of uncertainty in future SDPs.
4. Prior to starting an SDP, the NRC and Licensee should agree to the boundary conditions and assumptions needed to model the impact of the finding
5. The same process (see Recommendation above) should be used to validate the SDP results as is used for the base model.
6. Need to have open communication between the SRA and utility PRA personnel

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SPAR Model Philosophy Rev. 1.pptx

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Standardized Plant Analysis Risk (SPAR) Model Philosophy

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Model Uses

- Reactor Oversight
  - Significance Determination Process (SDP)
  - Notices of Enforcement Discretion (NOEDs)
  - Management Directive MD 8.3 Incident Investigation Assessments
  - Accident Sequence Precursor Program
- System & Component Studies
- Generic Issue Screening
- Special Studies

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SPAR Technical Adequacy

- Unlike licensee PRA models that support risk-informed licensing actions, SPAR models are not required to minimum technical adequacy requirements (e.g., RG 1.200).
- SPAR QA program helps to ensure SPAR models reflect as-built, as-operated plant
- Process controls also help to ensure quality
  - Trained/certified analysts
  - Internal reviews
  - External reviews

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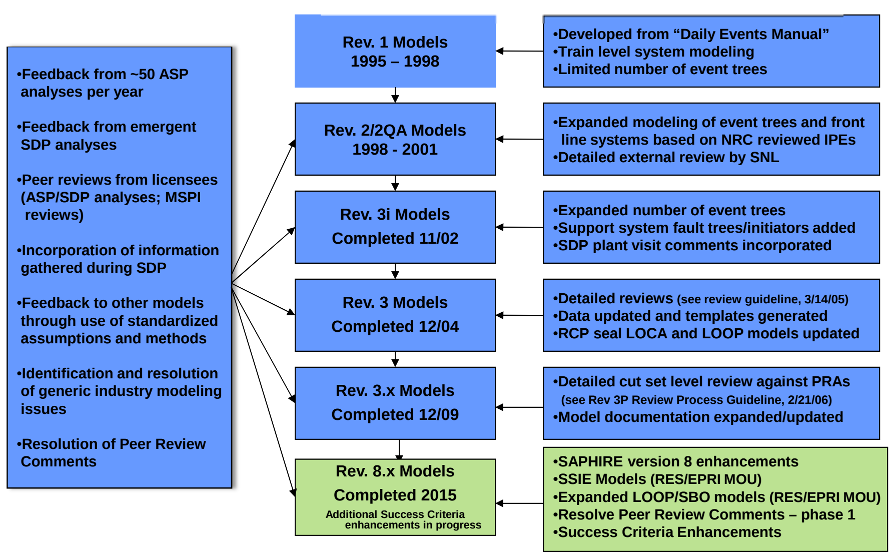
SPAR Level 1 Model Development



Capabilities

- Operating Reactors
  - 75 full-power, internal events models representing all operating plants
  - 18 IPEEE-based external hazard models
  - 4 “All Hazard Models”
  - 8 Shutdown template models
  - 3 Level 2 feasibility models
  - 1 Integrated Capability Model
- New Reactors
  - ABWR – GE & Toshiba (SD)
  - APWR
  - AP1000 (seismic, flooding, fire, LPSD)
  - US EPR

Development Philosophy

- Provide independent, plant-specific PRA models for use by agency risk analysts
  - “[I]ndependent oversight of licensee performance is critical for effective NRC oversight and is an important aspect of upholding public confidence in the [SDP] process” (letter from EDO to NEI, October 2007, ML072490566)
- Use standardized modeling conventions
  - Standardization approach supports plant-specific modeling
  - Ease of use for agency analysts
  - Efficient model maintenance and updating

Development Philosophy

- Support event and condition assessment (ECA) activities
  - SAPHIRE user "workspaces" structured to support ROP
  - SPAR models designed to efficiently address typical ECA activities (e.g., CCF, LOOP modeling)
- Apply agency resources in a cost-effective manner
  - SPAR models generally not as detailed as licensee models (with some exceptions)
  - SPAR generally relies on licensee PRA modeling assumptions (supported with some independent analysis)

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Quality Assurance

- SPAR Quality Assurance Plan
- SPAR Project Manager Handbook
- Risk Assessment of Operational Events (RASP) Handbook
  - Helps to ensure that the SPAR models are of adequate quality, reflect the as-built, as-operated plant for the problem being analyzed, and are used in a consistent manner.
- Model Maker Guidelines (MMGs)
  - All Hazard Models
  - Shutdown
  - Integrated Capability Modeling

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Quality Assurance

- Onsite verification reviews
  - Onsite reviews conducted during MSPI benchmarking activities
  - Onsite reviews conducted for new modeling elements (e.g., shutdown, fire, external hazards)
- SPAR Configuration/Version Control
- SAPHIRE Quality Assurance Plan
  - Independent Verification and Validation for SAPHIRE 8
  - NUREG/BR-0167, “Software Quality Assurance Program and Guidelines” compliant QA program, including annual audits

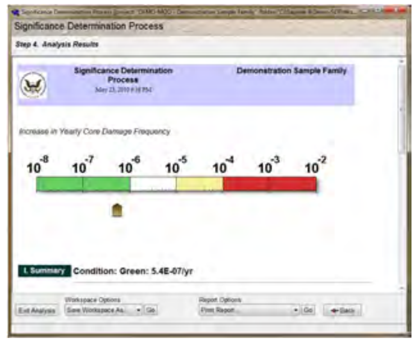
Maintenance Program

- Major updates are performed on approximately 8-12 SPAR models per year based on feedback from model users and licensees
  - Less significant model changes are performed on an additional 20-30 models per year to support risk assessments for specific regulatory applications
  - Approximately one half of the plant-specific SPAR models are typically updated in a given year

SAPHIRE

SAPHIRE (Systems Analysis Programs for Hands-on Integrated Reliability Evaluation)

- Performs logic solving and Boolean reduction to generate PRA cutsets from event tree/fault tree models
- NRC sponsored code developed at Idaho National Lab.
- Developed to Support Event and Condition and Analysis
  - Workspaces (SDP, ECA, GA)
  - CCF Module
  - Cut set editor
  - Reporting Capabilities
- NUREG/BR-0167 Compliant QA Program



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Questions?

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Outline

Considerations for using other than the Standardized Plant Analysis Risk (SPAR) models

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**Considerations for using other than the
Standardized Plant Analysis Risk (SPAR) models
Outline**

1. **Summary of Key Considerations for using licensees' PRA Models**
    - 1.1. Regulatory Processes
    - 1.2. PRA Policy Statement
    - 1.3. Model Quality
    - 1.4. Maintain independence of NRC
    - 1.5. Standardization of modeling and assessment techniques
    - 1.6. Use by the NRC staff of licensees' PRA models
    - 1.7. Effect on other NRC Programs
    - 1.8. Costs

2. **Regulatory Processes**
    - 2.1. Reactor Oversight Process (ROP)
        - 2.1.1. ROP is an NRC process
    - 2.2. Significance Determination Process (SDP)
        - 2.2.1. Today's SDP outcomes using NRC versus licensee PRA
            - 2.2.1.1. The PRA models are often in close agreement.
            - 2.2.1.2. Differences in SDP outcomes between the NRC and the licensee are driven by factors other than the baseline PRA model
                - 2.2.1.2.1. Engineering assumptions
                - 2.2.1.2.2. Modeling assumptions
                - 2.2.1.2.3. Human reliability assumptions
                - 2.2.1.2.4. Other …
            - 2.2.1.3. These issues are also applicable to the other regulatory processes and other risk-informed licensing related activities
    - 2.3. MD 8.3 - NRC Incident Investigation Program
    - 2.4. Notice of Enforcement Discretion (NOEDs)
    - 2.5. Technical basis for rulemaking
    - 2.6. Generic issues
    - 2.7. Other risk-informed licensing related activities

3. **PRA Policy Statement**
    - 3.1. The PRA Policy Statement encouraged the NRC to increase the use and application of PRA to the greatest extent practical.
    - 3.2. SPAR models are one of the key incarnations of that effort.

3.3. Eliminating SPAR models would violate the spirit of that policy because it could undermine confidence in PRA-based findings.

4. **Model Quality**

4.1. SPAR models have been peer reviewed by industry led peer review teams[1]

4.1.1. SPAR models were determined to be adequate for their intended application

4.1.2. Confidence on the part of staff and industry that the current generation of SPAR models accurately portray the plants that they model.

5. Maintain independence of NRC

5.1. ROP provides for an independent regulatory assessment of licensee performance

5.1.1. Staff may lose ability to verify - "trust but verify"

5.1.2. Licensee's initially indicate an event as low safety significance in LERs that are later established as a greater than Green finding

5.2. Conflict of interest issues

5.2.1. Since the ROP is an NRC process, how will the appropriate level of independence be established if the licensee's PRA is used?

5.2.1.1. Does the independent manipulation of the licensee's model by NRC staff/contractors establish an appropriate level of independence?

5.2.1.2. OGC may need to endorse use of licensee PRA

5.2.2. Will the licensee perform the assessment

5.2.2.1. OGC may need to endorse allowing the licensee to perform the assessment

5.3. Public confidence

5.3.1. Use of licensee PRA and/or allowing the licensee to perform the assessment could erode public confidence

5.3.2. In effect, the licensee is communicating events and degraded plant conditions to the public and other stakeholders if they perform the analysis.

6. Standardization of modeling and assessment techniques

6.1. Standardization provides for:

6.1.1. Efficiency

6.1.2. Consistency

6.1.3. Automation

[1] One typical BWR and one typical PWR SPAR model was peer reviewed since they are standardized. Recently completed a multi-year peer review resolution activity to address peer review findings across all SPAR models.

6.2. Efficiency of standardization

6.2.1. Modeling assumptions

6.2.2. Modeling conventions

6.2.3. Naming schemes (basic events, fault trees, event tress, etc.)

6.2.4. Post processing rule construction

6.2.5. Reporting functions (built into SAPHIRE)

6.2.6. Consistency in event tree/fault tree construction

6.2.7. Single Software platform

6.3. Consistency

6.3.1. Uniformity of assessments (RASP Handbooks)

6.3.1.1. Risk Assessment Standardization Project (RASP) Handbooks

6.3.1.2. Uniform because SPAR models are standardized

6.4. Automation

6.4.1. Software platform is standardized (SAPHIRE)

6.4.1.1. SAPHIRE was developed and modified specifically to support the regulatory processes

6.4.1.2. SAPHIRE has evolved over the years to meet the needs of the NRC analyst to help them better perform their tasks when utilizing the SPAR models. These features were built directly into SAPHIRE to eliminate the analyst performing offline calculations and then placing those calculated probabilities back into the SPAR model.

6.4.1.3. Reporting functions (built into SAPHIRE)

6.5. Experience indicates the use of NRC developed standardized models supports the principles of good regulation: independence, openness, efficiency, clarity, and reliability.

7. Use by the NRC staff of licensees' PRA models

7.1. Additional logistical and resource requirements

7.1.1. Seventy (70) plus licensee PRAs

7.1.1.1. No standardization

7.1.1.1.1. No Standard Modeling assumptions

7.1.1.1.2. No Standard Modeling conventions

7.1.1.1.3. No Standard Naming schemes (basic events, fault trees, event tress, etc.)

7.1.1.1.4. No Standard Post processing rule construction

7.1.1.2. NRC Staff/SRAs will need to learn nuances of each licensee PRA

7.1.2. Four (4) different commercial software platforms

7.1.2.1. CAFTA (EPRI)

7.1.2.2. WinNUPRA (Scientech)

7.1.2.3. Riskman (ABS Consulting)

7.1.2.3.1. Cutsets are problematic (used to gain understanding of risk insights)

7.1.2.4. RiskSpectrum (Lloyd´s Register Consulting, Sweden)

7.1.3. All lack reporting features of SAPHIRE

7.1.4. All lack automation and easy to use analysis tools in SAPHIRE

7.2. Need for additional NRC risk analysts

7.2.1. Additional staff training requirements

7.3. Management and control of licensee models and model updates

7.3.1. Non-uniform modeling assumptions and limitations

7.3.1.1. Each model will need to be examined and understood

7.3.2. Availability of PRA models and supporting documentation

7.3.2.1. Will all of the licensees formally submit their PRA to NRC?

7.3.2.1.1. Under oath and affirmation?

7.3.2.1.2. Subject to 10 CFR 50.9?

7.3.3. How will staff ensure NRC has the latest licensee model?

7.3.4. RASP Handbook provides for uniformity of assessments

7.3.4.1. Assumes models are standardized and well understood

7.3.4.2. Will necessitate a complex revision

8. Effect on other NRC Programs that use SPAR models

8.1. Accident Sequence Precursor (ASP) program

8.1.1. Abnormal occurrence report to Congress

8.2. Industry trends/operating experience programs

8.3. New Reactors (PRA & licensing)

8.4. Inspection programs

8.4.1. Inspection resources

8.4.2. Inspection decisions will become reactive based on deterministic criteria alone

8.5. Use of SPAR models to support system and component studies

8.5.1. Would inhibit our ability to develop tailored models when new situations arise.

8.6. SPAR models are used to develop Plant Information Risk eBooks (PRIBS) – superseded the SDP Notebooks

8.7. SPAR Models used for other purposes

8.7.1. Answer Commission questions

8.7.2. Japan Lesson Learned related issues (flooding, vents, seismic)

8.7.2.1. SPAR model results (CDFs) used to assist in the resolution of Fukushima NTTF Rec. 5.2 (containment venting for plants other than BWR with Mark I and Mark II containments), and Rec. 6 (hydrogen control and mitigation).

8.7.2.2. SPAR model data (equipment failure rates) supported the risk evaluation of Fukushima NTTF Rec. 5.1 (containment venting in BWR Mark I and Mark II plants)

8.7.3. SPAR-EE models supported GI-199 (updated seismic hazard curves for plants east of the Rocky Mountains)

8.7.4. Gain understanding of key basic events in the SPAR fire PRA models

8.7.5. SPAR models used to identify the most likely core-damage sequences for SOARCA analysis, as well as other important input.

8.7.6. SPAR models and data (equipment failure rates) supported staff's analysis of containment accident pressure (CAP) credit in BWR plants.

8.7.7. Gain understanding of CDFs as estimated by SPAR (supported work for Commissioner Apostolakis, 2013).

8.7.8. NRR made heavy use of the SPAR models (event trees) while reviewing the Browns Ferry extended power uprate (EPU) license amendment request.

9. Costs

9.1. Costs to both NRC and Industry

9.2. NRC

9.2.1. Licensee model reviews

9.2.1.1. NRC Staff/SRAs will need to learn nuances of each licensee PRA

9.2.1.1.1. Continuing effort as plants make modifications and update/revise their PRA.

9.2.2. Logistical requirements

9.2.2.1. Control and distribution of licensee models

9.2.3. Training

9.2.3.1. Training on multiple software platforms

9.2.3.2. Potential impact on SRA qualifications

9.2.3.3. Potential impact on established NRC PRA and PRA related training programs

9.2.4. Commercial Software licenses

9.2.4.1. Multiple versions used by the industry

9.2.4.2. Commercial PRA software typically requires additional software (licenses) to be comparable to SAPHIRE (e.g. CAFTA/FTREX)

9.2.5. Additional analyst staff

9.2.6. Other

9.3. Industry

9.3.1. Cost for licensee to submit their PRA to NRC

9.3.1.1. Will ALL licensees voluntarily submit their PRA to NRC?

9.3.1.1.1. If not, we will need to maintain limited number of SPAR models.

9.3.1.2. Need for complete documentation of licensee PRA, could be extensive

9.3.2. Cost for a minimum of model standardization

9.3.3. Cost to implement a single RG 1.200 compliant standardized modeling approach across multiple analysis platform

9.3.3.1. Re-invent a RASP Handbook for uniformity of assessments

9.3.4. Cost to implement SAPHIRE reporting features and other automation tools

9.3.5. How will industry provide support to NRC Analysts?

9.3.5.1. INL is currently responding to approximately 2 requests for assistance per day via the Technical Support contract

9.3.6. Other