NEI White Papers on Crediting Portable Equipment in RI Decision Making (Comments from NRC)

NEI FRIDM Task Force
March 16, 2016
NRC Public Meeting at One White Flint

FRIDM Task Force Activities

Maximize Benefit of Equipment in Reducing Plant Risk

- Developing guidance on how to use risk insights in identifying opportunities to maximize the benefit of portable equipment

PRA Data Collection and Methods Optimization

- Data collection to be used in the development of portable equipment failure frequencies
- Optimization of methods to incorporate unique considerations

PRA Modeling Considerations

- Developing guidance to identify specific considerations for PRA modeling of portable equipment
- To be integrated with white papers below into full guidance

Semi Quantitative Stream Lined Approach

- Developed white paper to describe a bounding approach to estimate risk reduction
- Submitted to NRC for review and comment

Qualitative Considerations

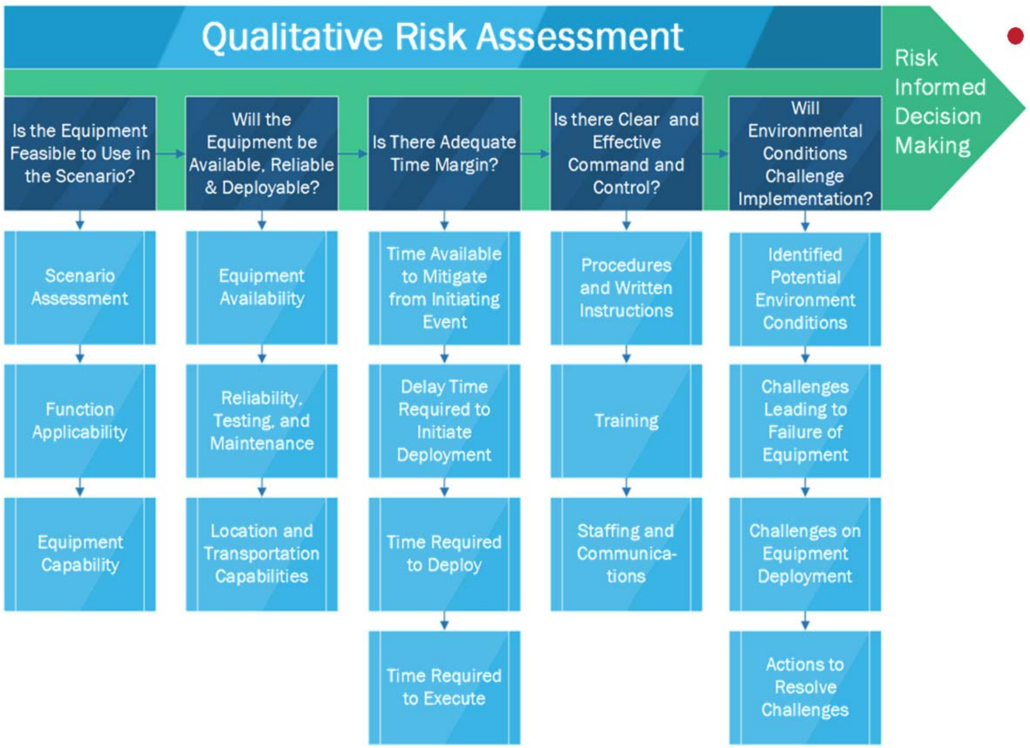
- Developed white paper to establish key considerations to be evaluated for crediting portable equipment in risk assessments
- Submitted to NRC for review and comment

NEI

EPRI

NEI Guidance

General Considerations



- Common considerations between all three approaches, however:
  - White papers not intended to meet RG 1.200 requirements
  - Qualitative white paper not intended to establish any <u>specific</u> level of credit

Potential Areas of Benefit

White papers are beneficial in many areas but are written to be independent of any specific application

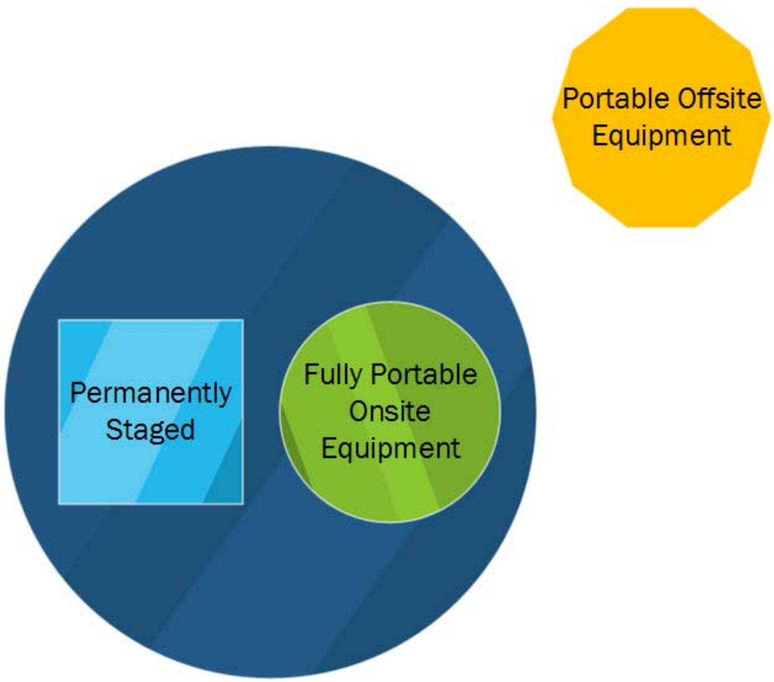
Activity	Areas of Potential Benefit						
	SDP	NOEDs	MSPI	Maintenance Rule (a)(4)*		RG 1.200 Applications	
				Defense in Depth	Risk Calculations	Defense in Depth	Risk Calculations
White Paper on Qualitative Considerations and Approach	X	X		X		X	
White Paper on Semi Quantitative Stream Lined Approach	X	X			X		
NEI Guidance for PRA Modeling	X	X	X		X		X
EPRI Technical Report on Generic Failure Frequencies	X	X	X		X		X

*Online and Outage Risk Assessments

Scope of Equipment

Scope includes the use of any portable equipment that can help reduce plant risk independent of the original strategy or events they were designed for

Applicability of Equipment



- **On-site portable equipment** – <u>Applicable</u>
- **On-site permanently staged portable equipment** – <u>Applicable</u>
- **Off-site portable equipment** – <u>Applicable</u> – *must account for mission time of the scenario before credit is established*

FLEX Validation Considerations

- Design changes completed
- FLEX Program Document completed
- Program changes/inter-ties (e.g., PMs, security, etc.) completed
- On-site storage facility or facilities completed
- All phase 2 equipment and supplies in credited locations
- RRC Response Plan completed
- Off-site staging area(s) established and functional
- Consistent with NEI 12-01 Phase 2 staffing analysis

FLEX Validation Considerations

- Staffing study
  - Accepted training process utilized
  - Includes on-shift and ERO personnel
- Procedures (EOPs, FSGs, etc.) issued, verified & validated by one or more of the following methods as appropriate:
  - Use of communications methods expected to be available under BDBEE/ELAP conditions for performance of the task
  - Procedure walk-throughs
  - Table-tops
  - Simulator scenario(s)
  - Timelines for time sensitive tasks identified in OIP
  - Justification for deviations from OG guidelines

FLEX Validation Considerations

- Appropriate time sensitive tasks identified in OIP validated using one or more of the following (as appropriate)
  - Full or partial deployment of equipment
  - Allowance (margin) for debris or security barrier removal if required
  - Simulator scenario(s)
  - In-plant walk-throughs
  - Tabletops or expert panels
  - Timed JPMs
  - Comparison to previous timed tasks (e.g. existing emergency procedures actions or B.5.b tasks)
  - Use of communications methods expected to be available under BDBEE/ELAP conditions for performance of the task

Initiation of an ELAP

- https://vimeo.com/user14666519/review/127220397/5ec0aebb34

FLEX Validations and Audits

- NRC Senior Management has publicly stated that they are "confident" in the ability of utilities to deploy FLEX based on the sites validation activites and NRC staff audits

Streamlined Approach for Crediting Portable Equipment in RI Decision Making (Comments from NRC)

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Purpose of Streamlined Approach

- FLEX capabilities can help reduce the risk from some contributors in plant-specific PRAs, e.g., station blackout scenarios
- It is desirable to have a means to get some numerical credit for FLEX in regulatory interactions, e.g., SDPs, NOEDs, etc.
- The streamlined quantitative approach is not intended to meet the PRA quality requirements for a RG-1.200 application

Structure and Considerations

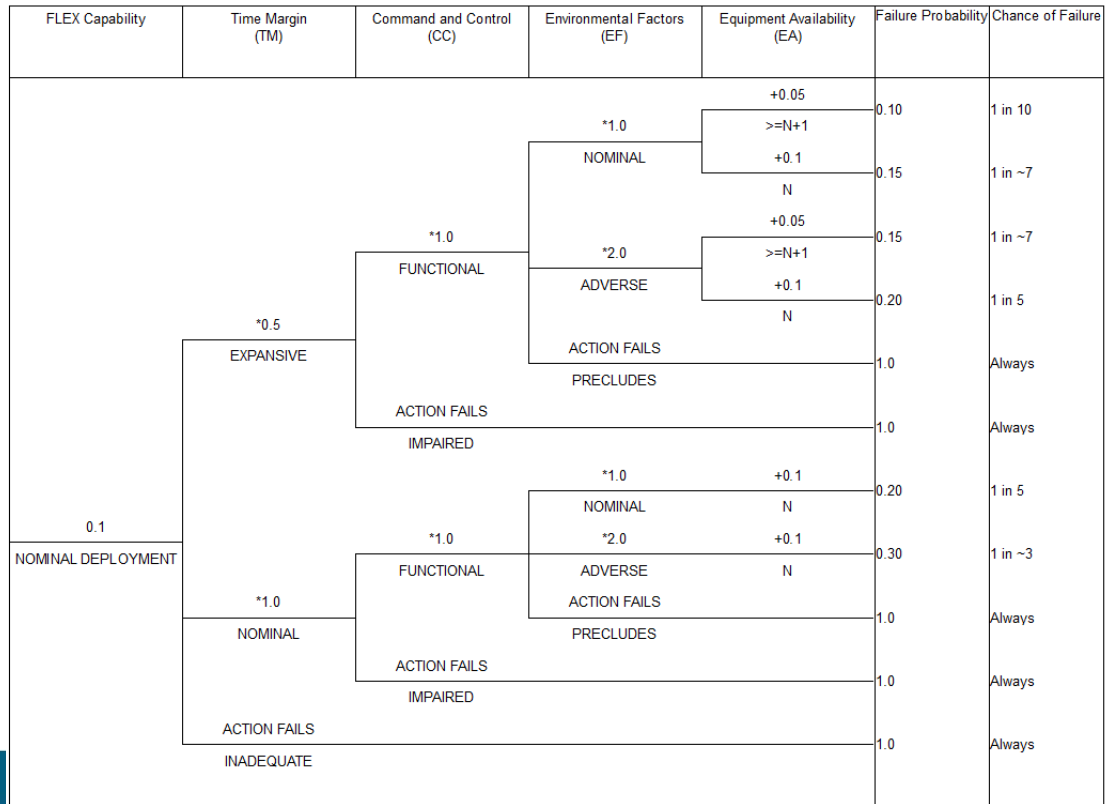
- Mirrors factors considered in qualitative assessment
  - Feasibility Assessment
  - Time Margin
  - Command and Control
  - Environmental Factors
  - Equipment Reliability and Availability
- Implemented in decision tree format

Issue #1: Justification for the Use of 0.1 as a Screening Value

Streamlined Quantitative Approach

- Uses a holistic construct to assign an overall failure probability for implementing an overall mitigating strategy
  - It does not represent a specific human reliability analysis methodology
- The final failure probabilities utilized are in line with generally accepted likelihood values (i.e., 0.1 to 0.3 failure probabilities) for something deemed feasible and likely to succeed

Streamlined Quantitative Approach Decision Tree



Streamlined Quantitative Approach

- For example, the Intergovernmental Panel on Climate Change (IPCC) provides the following guidance for risk communication on the consistent treatment of uncertainties to its authors[1]:

Table 1. Likelihood Scale	
Term*	**Likelihood of the Outcome**
Virtually certain	99-100% probability
Very likely	90-100% probability
Likely	66-100% probability
About as likely as not	33 to 66% probability
Unlikely	0-33% probability
Very unlikely	0-10% probability
Exceptionally unlikely	0-1% probability

- For the streamlined approach
  - Nominal deployment is solidly in the “likely” range
  - For cases that are ultimately deemed less likely to succeed, the final value from the decision tree is one that falls further into the “likely” range from the IPCC likelihood scale
  - If confidence cannot be established that the strategy is at least “likely” to succeed, then no credit is taken

[1] *Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties*, Intergovernmental Panel on Climate Change, July 2010.

Streamlined Quantitative Approach

- Similarly, the Committee of Sponsoring Organizations of the Treadway Commission (COSO) published a framework and guidance for thought leadership in enterprise risk management. The resulting Deloitte and Touche LLP paper entitled "Risk Assessment in Practice" provides the following illustrative example [2]:

Illustrative Likelihood Scale

Rating	Probability Descriptor	Definition
5	Almost certain	90% or greater chance of occurrence over life of asset or project
4	Likely	65% up to 90% chance of occurrence over life of asset or project
3	Possible	35% up to 65% chance of occurrence over life of asset or project
2	Unlikely	10% up to 35% chance of occurrence over life of asset or project
1	Rare	<10% chance of occurrence over life of asset or project

- Again, for the streamlined approach
  - Nominal deployment is solidly in the "likely" range
  - For cases that are ultimately deemed less likely to succeed, the final value from the decision tree is one that falls further into the "likely" range from the COSO likelihood scale
  - If confidence cannot be established that the strategy is at least "likely" to succeed, then no credit is taken

Streamlined Quantitative Approach

- Finally, the use of 0.1 failure probability is consistent with accepted practice in Level 2 analysis for assigning conditional probabilities to events with "state-of-knowledge" uncertainties[3]:

Value	Description
0.999	The indicated outcome is ALMOST CERTAIN.
0.99	The indicated outcome is EXTREMELY LIKELY.
0.95	The indicated outcome is VERY LIKELY.
0.9	The indicated outcome is LIKELY.
0.5	The indicated outcome is fully POSSIBLE.
0.1	The indicated outcome is UNLIKELY.
0.05	The indicated outcome is VERY UNLIKELY.
0.01	The indicated outcome is EXTRMELY UNLIKELY.

[3] Excerpts from Table 4-1 of NUREG/CR-6771, *GSI-191: The Impact of Debris Induced Loss of ECCS Recirculation on PWR Core Damage Frequency,* August 2002. Based on *Procedures for Conducting Probabilistic Safety Assessments of Nuclear Power Plants (Level 2)*, Safety Series No. 50-P8, International Atomic Energy Agency, Vienna 1995.

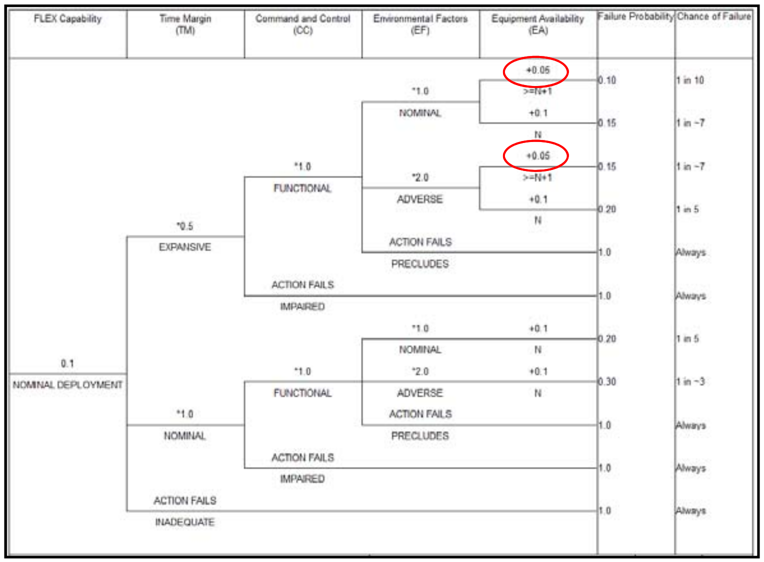
Issue #2: Missing Diagnosis Element in Quantitative Analysis

Streamlined Quantitative Approach

- Uses a holistic construct to assign an overall failure probability for implementing a mitigation strategy
- It does not represent a specific human reliability analysis methodology
- However, white paper will be updated to note that the assumed delay time will encompass the diagnosis time
  - Cognitive portion of HEP embedded in overall failure probability

Issue #3: Justification for Use of 0.01 for N+1 Equipment

Streamlined Quantitative Approach



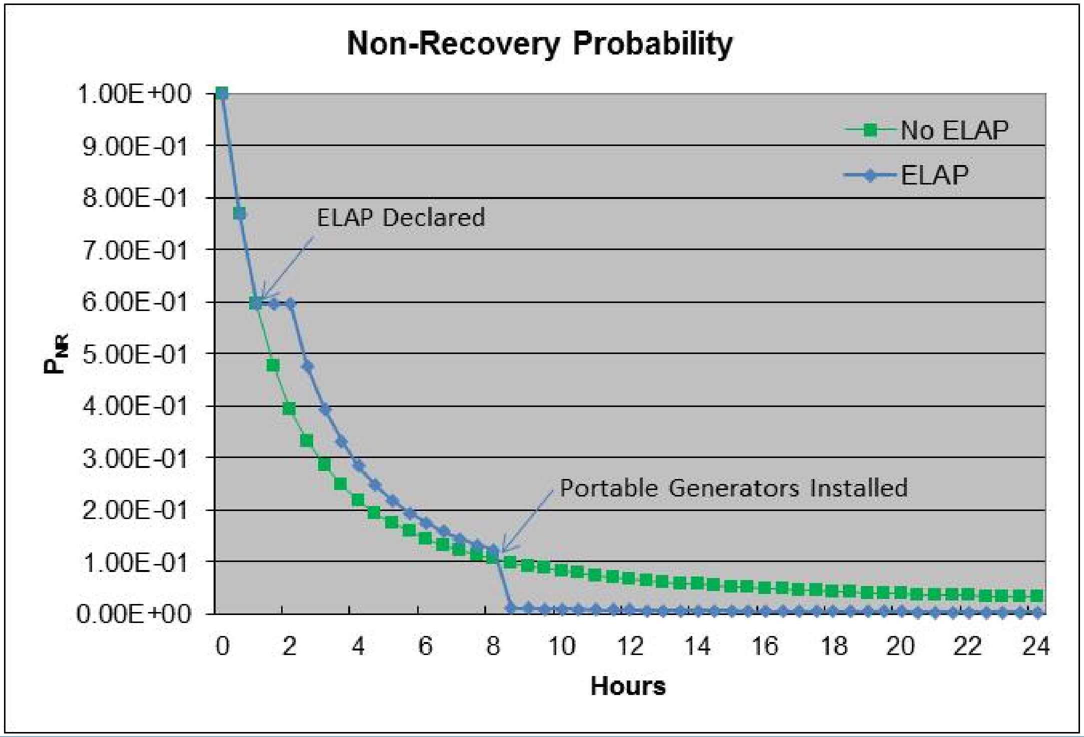
- Updated decision tree per the NRC recommendation to use 0.05 instead of 0.01 for the N+1 equipment branches in the streamlined approach
- However, will note that this value could be replaced with a value based on additional data as it becomes available

Issue #4: Potential Negative Impacts Associated with Deep DC Load Shedding

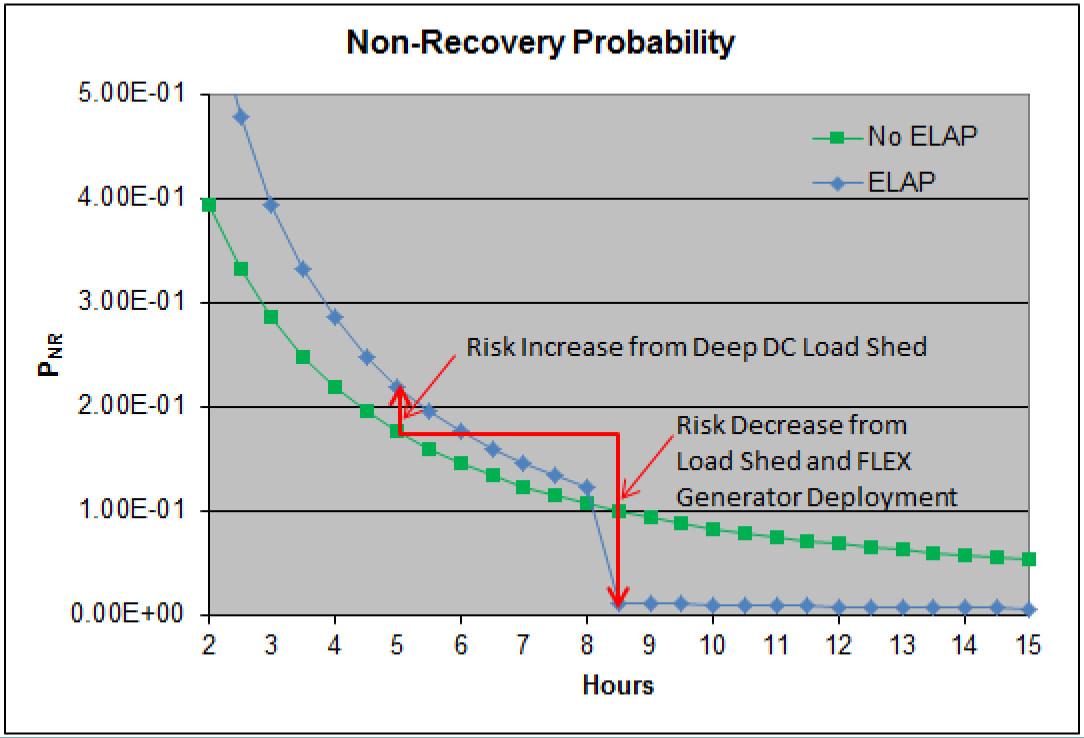
Deep DC Load Shed Impacts

- If deep load shed fails and there is not sufficient time to establish portable generators, then the applicable SBO sequences will go to core damage (as before without credit for deep load shed)
- Major impact of deep load shed is on potential time required to restore off-site (or on-site) power
  - For example, if recovery of off site power takes 1 hour longer than normal with a deep load shed, non-recovery probabilities utilized in model may shift

Example Case



Example Case (Cont'd)



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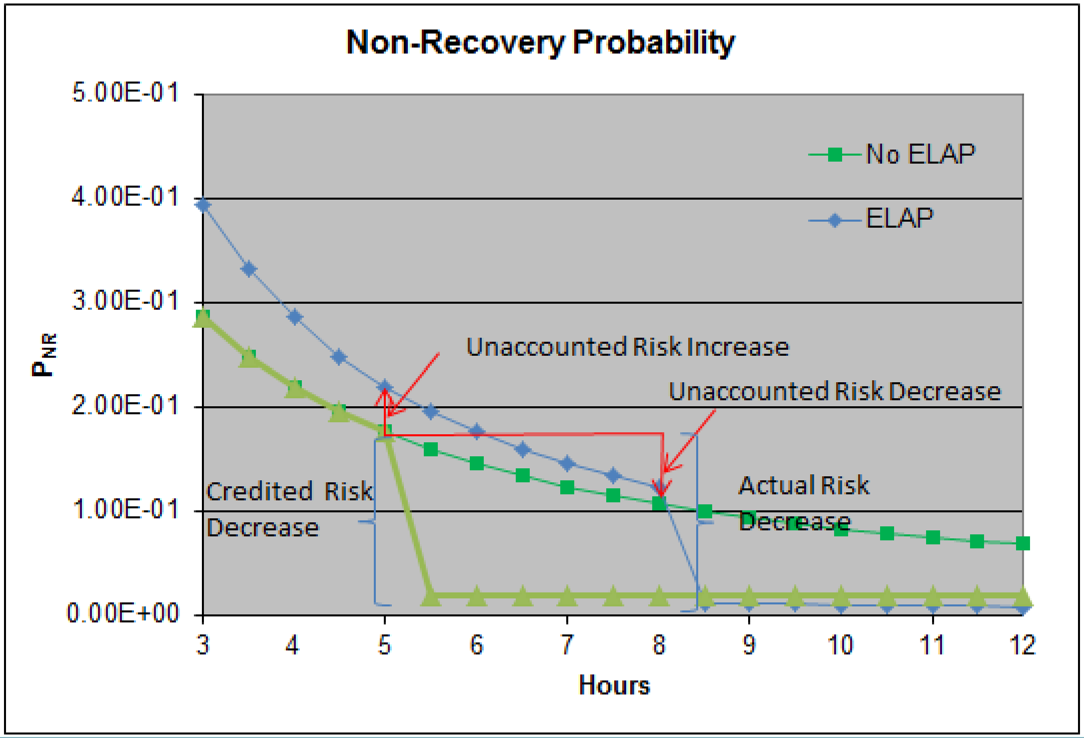
Example Case (Cont'd)



Deep DC Load Shed Summary

- In the streamlined approach, the unaccounted for risk decrease should always be larger than the unaccounted for risk increase
  - Assumes extra time available from extended battery life is more than any extra time required to restore power if it becomes available
  - Exception would be if deep load shed precludes timely off-site or on-site power restoration

Issue #5: Changes to Base CDF

Streamlined Quantitative Approach

- Agree that the impact of FLEX equipment needs to be addressed in the base case as well as the non-conforming case to get a proper assessment of the increase in risk
  - This aspect was acknowledged in the last note in the appendix to the white paper
- Will include additional guidance for this aspect in the main body of the white paper

Issue #6: Implications of Crediting of MS\FLEX in areas other than Beyond Design Basis Events (BDBE) in the Reactor Oversight Process (ROP)

Issue #7: Safe Stable State

Safe Stable State Definition

- NUREG-2122, *Glossary of Risk-Related Terms in Support of Risk-Informed Decisionmaking* provides the following definition:
  - In a PRA, safe stable states are represented by success paths in modeling of accident sequences. A safe stable state implies that the plant conditions are controllable within the success criteria for maintenance of safety functions.
  - The ASME/ANS PRA Standard defines the term safe stable state as "a plant condition, following an initiating event, in which reactor coolant system conditions are controllable at or near desired values."
- Implementation of FLEX strategies is consistent with the PRA Standard definition of a Safe Stable State