Illustration of Prioritization Process

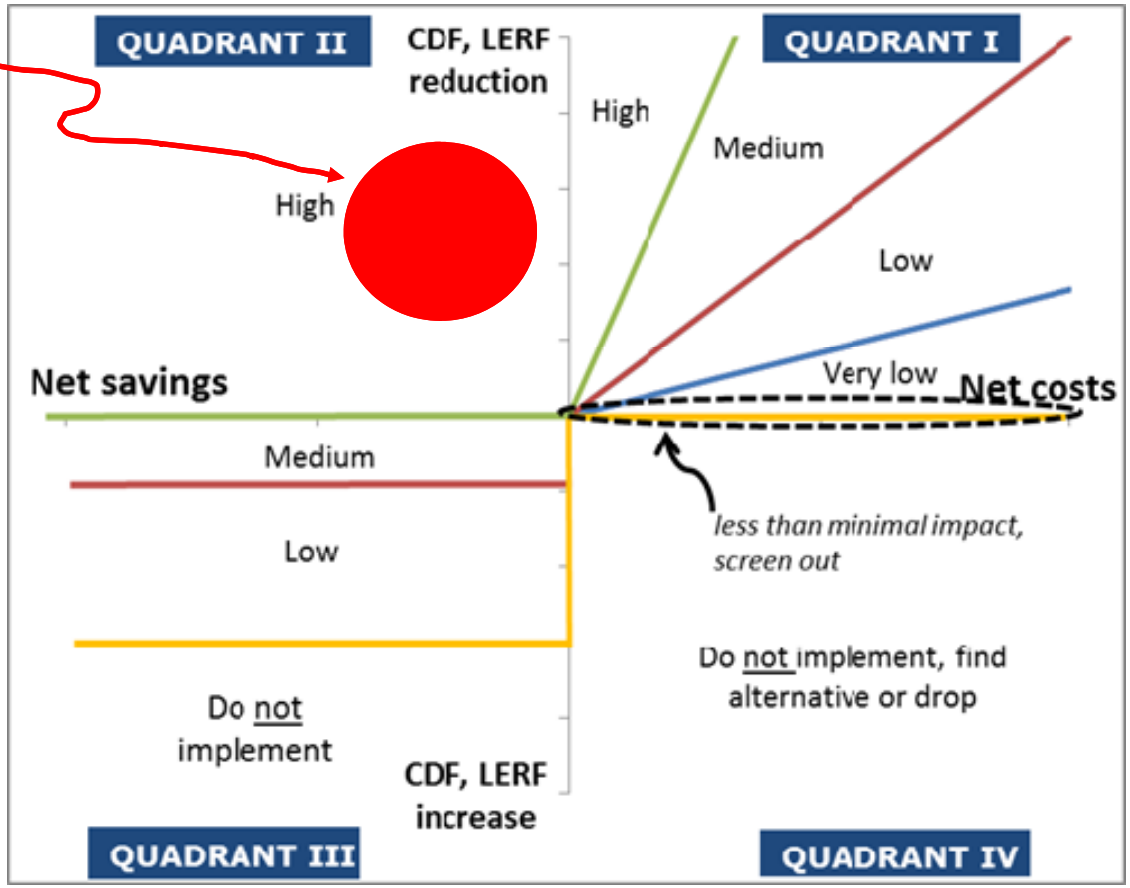
- Improved reactor coolant pump seal package
- Fitness for Duty – enhanced testing

Aspects of Improved RCP Seals to Evaluate

- Improved system and plant performance, e.g., thermal-hydraulic stability of leakoff/bleedoff flows
  - Reduced forced shutdowns, reduced transition risk
  - Not addressed in today's evaluation
- Spontaneous RCP seal LOCAs
- Enhanced performance during loss of RCP seal cooling and station blackout events

Visual on Benefits versus Costs

Potential net savings and improved safety



Not to scale

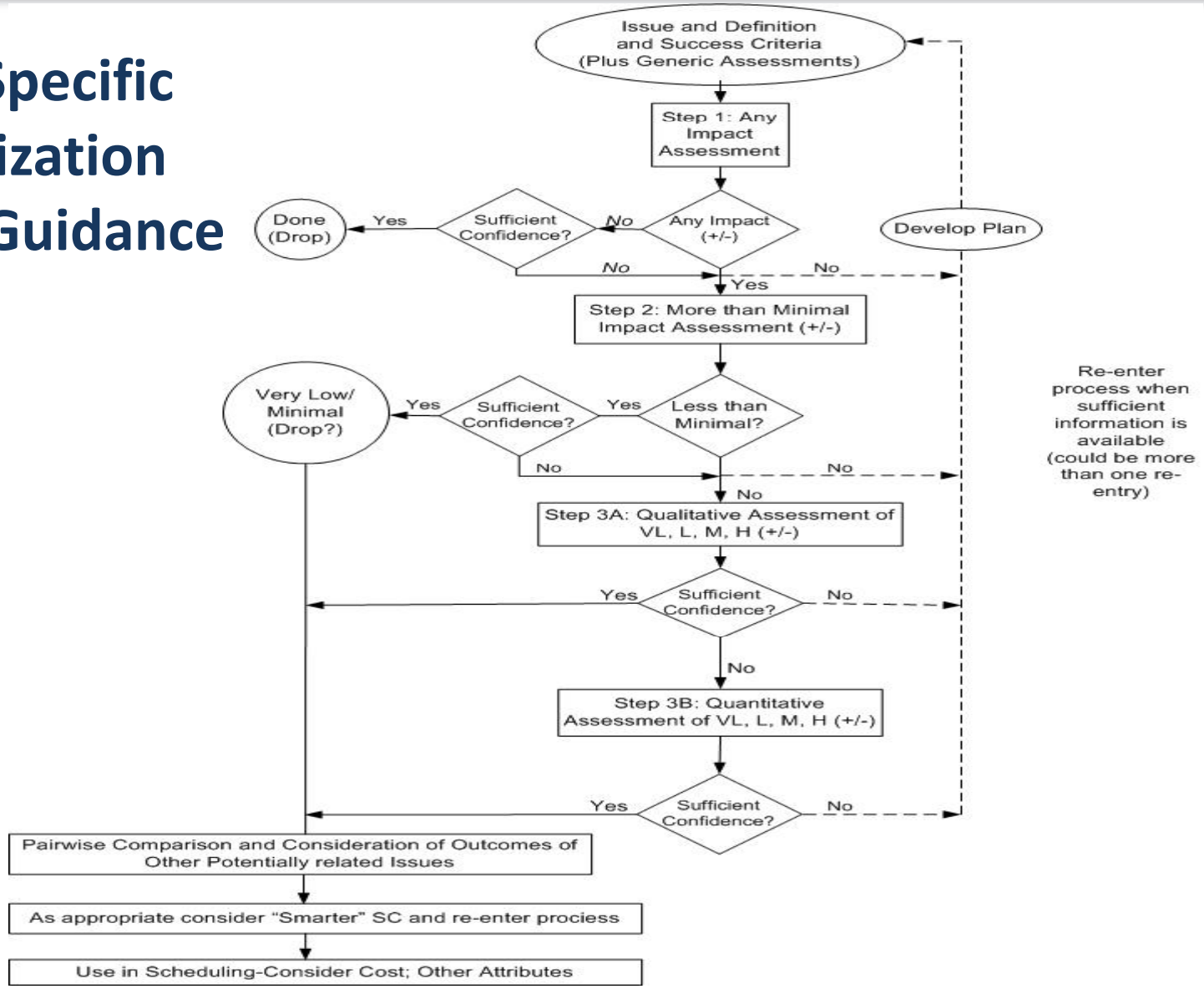
Ground Rules for Tabletop Exercises (sample)

Tabletop Exercise #1: Reactor Coolant Pump Seal Improvement Prioritization	
Dates (tentative)	1. Generic characterization and assessment, December xx, 2013 2. Plant-specific prioritization, December xx, 2013 or January xx, 2014
Location	NRC Rockville offices, Room TBD
Time	TBD
Objective of tabletop	a) To exercise the draft guidance documents using a realistic example, b) To assess whether the process is *structured, robust, transparent, and straightforward,* and c) To identify areas for improvement in the guidance.
Scope of exercise	1. For the generic assessment, assess the issues associated with RCP seal performance improvement in PWRs and develop the generic characterization which will serve as input to the plant-specific evaluation(s) 2. Prioritize the proposed RCP seal replacement project on a plant-specific basis using the generic characterization, the risk insights from the plant PRA, and other available information
Industry guidance documents	1. Draft NEI *Guidelines for Prioritization and Scheduling Implementation* 2. Draft NEI *Guidance for Generic Assessment Expert Team (Initiative for Improving Nuclear Safety and Regulatory Efficiency)* 3. Draft NEI *Guidance for Integrated Decision Making Panel (Initiative for Improving Nuclear Safety and Regulatory Efficiency)*
Reference documents	1. WCAP-15603-A, Rev. 1 (non-proprietary) (WOG 2000 RCP seal model) 2. WCAP-16175-NP-A, Rev. 0, (RCP seal failure model for CE NSSS) 3. NUREG-1560 (IPE insights) and NUREG-1742 (IPEEE insights) 4. Data NUREGs including NUREG/CR-6928, NUREG/CR-5750, and in particular NUREG/CR-6582 (PWR primary system leaks including RCP seal leakage events) 5. NEI 96-07 (guidance for 10CFR50.59 implementation) 6. RG 1.174 (risk-informed changes to licensing basis) 7. Plant-specific design information and PRA insights
Pre-tabletop activities	1. Participants to review operating experience with PWR RCP seal performance, particularly large leakage events 2. Participants should become familiar with RCP seal LOCA models for use in PRAs 3. Participants should review IPE/IPEEE insight documents and should be generally familiar with the risk significance of loss of RCP seal cooling events during station blackouts, support system initiators, and external events contributions 4. For the plant-specific prioritization, participants should have qualitative and quantitative risk results from the plant PRA
Tabletop activities	1. Discuss the tabletop exercise objective and desired outcomes 2. Use the guidance documents to characterize and prioritize the particular issue, RCP seal improvement, using Steps 1, 2 and 3A 3. Briefly document the results 4. Identify specific improvements to the guidance documents
Preliminary conclusions to draw from tabletop exercise	Determine a) whether guidance is adequately *structured, robust, transparent, and straightforward,* and b) whether the aids including tables, figures, screening questions, matrices, and worked examples are useful.
Lessons-learned	A list of the major lessons learned from the tabletop exercise should be carried forward to enhance the guidance documents and to improve future tabletop activities

Operating Experience with RCP Seal Leakage

- NUREG/CR-4400: 8 events with > 10 gpm from 1971-1985
  - Robinson (Westinghouse), May 1975, 500 gpm (max), in part due to loss of thermal barrier cooling
  - ANO Unit 1 (B&W), May 1980, 300 gpm (max)
- NUREG/CR-5750: No catastrophic failures 1981-1998
- NUREG/CR-6928: No small LOCAs 1988-2002, mean frequency ~ 6E-4/ reactor critical year

Plant-Specific Prioritization Process Guidance



Spontaneous RCP Seal LOCA Aspect – Step 1

Does the proposed activity or issue:

1. ☐ YES ☐ NO Result in an impact on the frequency of occurrence of a risk significant accident initiator?

Justification:

2. ☐ YES ☐ NO Result in an impact in the availability, reliability, or capability of SSCs and personnel relied upon to mitigate a risk significant transient, accident, or natural hazard?

Justification:

3. ☐ YES ☐ NO Result in an impact in the consequences of a risk significant accident sequence?

Justification:

Spontaneous RCP Seal LOCA Aspect – Step 1 (cont.)

4. ☐ YES ☐ NO Result in an impact in the capability of a fission product barrier?

Justification:

5. ☐ YES ☐ NO Result in an impact in defense-in-depth capability?

Examples include:

a. Strengthen balance of accident prevention and mitigation
b. Reduce reliance on programmatic activities
c. Reduce probability of common-cause failures

Justification:

If ALL the responses are NO and Confidence is sufficient, issue or activity has NO IMPACT and screens out (DROP) STOP.

If any of the responses is YES, then continue to **Step 2** or develop a plan.

Step 2 (More than Minimal Assessment):

Does the proposed activity or issue:

1. ☐ YES ☐ NO Result in more than a minimal decrease in frequency of occurrence of a risk significant accident initiator?

Justification:

2. ☐ YES ☐ NO Result in more than a minimal improvement in the availability, reliability, or capability of SSCs and personnel relied upon to mitigate a risk significant transient, accident, or natural hazard?

Justification:

3. ☐ YES ☐ NO Result in more than a minimal decrease in the consequences of a risk significant accident sequence?

Justification:

Step 2 (cont.):

4. ☐ YES ☐ NO Result in more than a minimal improvement in the capability of a fission product barrier?

Justification:

5. ☐ YES ☐ NO Result in more than a minimal improvement in defense-in-depth capability? Examples include:
   a. Strengthen balance of accident prevention and mitigation
   b. Reduce reliance on programmatic activities
   c. Reduce probability of common-cause failures

Justification:

If ALL the responses are NO and Confidence is sufficient, issue or activity screens to MINIMAL IMPACT.

If any of the responses is YES, then continue to **Step 3** or develop a plan.

Guidance for Step 2, Question 1:

Accident Initiator Categories (Representative)	Risk Significant?	More than Minimal Decrease ?
Transients initiated by frontline systems		
Transients initiated by support systems		
Primary system integrity loss (e.g. SGTR, RCP seal LOCA, LOCA)		
Secondary system integrity loss		
Internal flooding		
Internal fires		
Earthquakes		
External flooding		
Tornados and High Winds		
Other External Hazards		

Guidance for Step 2, Question 2:

Considerations	Potential Action Effect?	More than Minimal Improvement?
Changes in maintenance, training		
Changes in specific SSCs (e.g., installing a more reliable component)		
Changes in materials		
Equipment replacements to address age related degradation		
Changes in redundancy and diversity		
Additional of equipment		
Changes in operating practices		

Step 3A Qualitative Assessment

Matrix by Current Risk and Potential Impact

UB is upper bound of the risk range; Mid is "mid-range" (0.3 times UB); LB is factor of 10 lower than UB

Current Risk associated with Issue *Note: Address the specific issue first; then assess impacts on other risk contributors potentially impacted*	**Potential Impact of Action (Reduction in Risk)**					
	None	Very Small/Minimal	Small	Medium	High	Comments
	0%	0-25%	25-50%	50% to 90%	>90%	Can adjust these initial ranges as appropriate
	Outcome Note: Quantitative values are delta CDF/LERF					
Green (VL) LB	<VL/Green	<VL/Green	<VL/Green	<VL/Green	<VL/Green	No change
Green (VL) Mid	VL/Green	VL/Green	VL/Green	VL/Green	VL/Green	No change
Green (VL) UB	VL/Green	VL/Green	VL/Green	VL/Green	VL/Green	Maximum reduction is 1E-6/1E-7
White (L) LB	VL/Green	VL/Green	VL/Green	VL/Green	VL/Green	
White (L) Mid	VL/Green	VL/Green	L/White	L/White	L/White	White above 25% Category
White (L) UB	VL/Green	L/White	L/White	L/White	L/White	Maximum reduction is 1E-5/1E-6
Yellow (M) LB	VL/Green	L/White	L/White	L/White	L/White	
Yellow (M) Mid	VL/Green	L/White	M/Yellow	M/Yellow	M/Yellow	Only change is 25% Category
Yellow (M) UB	VL/Green	M/Yellow	M/Yellow	M/Yellow	M/Yellow	Maximum reduction is 1E-4/1E-5
Red (H) LB	?	M/Yellow	M/Yellow	M/Yellow	M/Yellow	Addressed by upper bound Yellow
Red (H) Mid	?	H/Red	H/Red	H/Red	H/Red	
Red (H) UB	?	H/Red	H/Red	H/Red	H/Red	

Step 3A Worksheet

- No RCP seal LOCAs in over 30 years
- NUREG/CR-6928 small LOCA initiator total frequency of $6x10^{-4}$ /yr as upper bound
- Per WCAP-16464-NP (WOG MSPI cross comparison)
  - Typical PWR Small LOCA CCDP ~ mid 10^{-4} to mid 10^{-3}
  - Typical PWR Small LOCA CDF: mid 10^{-7} to mid 10^{-6} /yr, a fraction attributable to spontaneous RCP seal LOCA
- Improved RCP seal may or may not reduce the small LOCA initiator frequency due to spontaneous RCP seal failure

Current risk level:

Potential % reduction in risk:

Consequential RCP Seal LOCA Aspect

- WCAP-15603-A Rev. 1 (non-proprietary): 0.21 conditional probability > 21 gpm/RCP for Westinghouse seals with qualified O-rings given loss of seal cooling

  (dependent on RCS depressurization and RCP trip)
- WCAP-16175-NP-A Rev. 0, Byron-Jackson N-9000 seal: data not publically available
- BNL-72341-2004: BJ N-9000 seal
  - 10^{-4} conditional probability of failure for < 4 hr
  - 10^{-3} conditional probability of failure for > 4 hr

  (dependent on closing bleedoff line and tripping RCPs)

Consequential RCP Seal LOCA Aspect – Step 1

Does the proposed activity or issue:

1. ☐ YES ☐ NO Result in an impact on the frequency of occurrence of a risk significant accident initiator?

Justification:

2. ☐ YES ☐ NO Result in an impact in the availability, reliability, or capability of SSCs and personnel relied upon to mitigate a risk significant transient, accident, or natural hazard?

Justification:

3. ☐ YES ☐ NO Result in an impact in the consequences of a risk significant accident sequence?

Justification:

Consequential RCP Seal LOCA Aspect – Step 1 (cont.)

4. ☐ YES ☐ NO Result in an impact in the capability of a fission product barrier?

Justification:

5. ☐ YES ☐ NO Result in an impact in defense-in-depth capability?

Examples include:

a. Strengthen balance of accident prevention and mitigation
b. Reduce reliance on programmatic activities
c. Reduce probability of common-cause failures

Justification:

If ALL the responses are NO and Confidence is sufficient, issue or activity has NO IMPACT and screens out (DROP) STOP.

If any of the responses is YES, then continue to **Step 2** or develop a plan.

Step 2 (More than Minimal Assessment):

Does the proposed activity or issue:

1. ☐ YES ☐ NO Result in more than a minimal decrease in frequency of occurrence of a risk significant accident initiator?

Justification:

2. ☐ YES ☐ NO Result in more than a minimal improvement in the availability, reliability, or capability of SSCs and personnel relied upon to mitigate a risk significant transient, accident, or natural hazard?

Justification:

3. ☐ YES ☐ NO Result in more than a minimal decrease in the consequences of a risk significant accident sequence?

Justification:

Step 2 (cont.):

4. ☐ YES ☐ NO Result in more than a minimal improvement in the capability of a fission product barrier?

Justification:

5. ☐ YES ☐ NO Result in more than a minimal improvement in defense-in-depth capability? Examples include:
   a. Strengthen balance of accident prevention and mitigation
   b. Reduce reliance on programmatic activities
   c. Reduce probability of common-cause failures

Justification:

If ALL the responses are NO and Confidence is sufficient, issue or activity screens to MINIMAL IMPACT.

If any of the responses is YES, then continue to **Step 3** or develop a plan.

Guidance for Step 2, Question 1:

Accident Initiator Categories (Representative)	Risk Significant?	More than Minimal Decrease ?
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Tornados and High Winds		
Other External Hazards		

Guidance for Step 2, Question 2:

Considerations	Potential Action Effect?	More than Minimal Improvement?
Changes in maintenance, training		
Changes in specific SSCs (e.g., installing a more reliable component)		
Changes in materials		
Equipment replacements to address age related degradation		
Changes in redundancy and diversity		
Additional of equipment		
Changes in operating practices		

Step 3A Qualitative Assessment

Matrix by Current Risk and Potential Impact

UB is upper bound of the risk range; Mid is "mid-range" (0.3 times UB); LB is factor of 10 lower than UB

Current Risk associated with Issue *Note: Address the specific issue first; then assess impacts on other risk contributors potentially impacted*	**Potential Impact of Action (Reduction in Risk)**					
	None	Very Small/Minimal	Small	Medium	High	Comments
	0%	0-25%	25-50%	50% to 90%	>90%	Can adjust these initial ranges as appropriate
	Outcome Note: Quantitative values are delta CDF/LERF					
Green (VL) LB	<VL/Green	<VL/Green	<VL/Green	<VL/Green	<VL/Green	No change
Green (VL) Mid	VL/Green	VL/Green	VL/Green	VL/Green	VL/Green	No change
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Red (H) LB	?	M/Yellow	M/Yellow	M/Yellow	M/Yellow	Addressed by upper bound Yellow
Red (H) Mid	?	H/Red	H/Red	H/Red	H/Red	
Red (H) UB	?	H/Red	H/Red	H/Red	H/Red	

Step 3A Worksheet

- Consequential seal LOCAs in PWRs contribute to CDF for
  - Station blackout events
  - Loss of component cooling water / service water events
  - Other losses of support systems
  - From internal hazards and also most external hazards
- May be of the order of 10s of percent of total CDF based on sources such as NUREG-1560 (IPE insights) as well as NRC's SPAR models and industry PRA models

Current risk level:

Potential % reduction in risk:

Part 26 Fitness for Duty (FFD) Rulemaking

Proposed Rule Change

The proposed rule change would amend the Commission's regulations by amending the drug testing requirements of 10 CFR part 26, "Fitness-for-Duty Programs," to incorporate state-of-the-art drug testing provisions, to correct known technical deficiencies, and to align the NRC's drug testing requirements with guidance issued by the Department of Health and Human Services.

Step 1: Screening on No Impact

Does the proposed activity or issue:

1. ☐ YES ☐ NO Result in an impact on the frequency of occurrence of a risk significant accident initiator?

Justification: The answer is uncertain as humans can cause an accident initiator, so assume **YES**

2. ☐ YES ☐ NO Result in an impact in the availability, reliability, or capability of SSCs and personnel relied upon to mitigate a risk significant transient, accident, or natural hazard?

Justification: The answer is uncertain as humans can affect SSCs and FFD could affect human performance, so assume **YES**

3. ☐ YES ☐ NO Result in an impact in the consequences of a risk significant accident sequence?

Justification: It is difficult to envision how a FFD issue could impact consequences (no discernible trend or impact) and **NO** is appropriate. Recall that any "Yes" results in continuing to Step 2.

Step 1: Screening (cont.)

4. ☐ YES ☐ NO Result in an impact in the capability of a fission product barrier?

Justification: It is difficult to envision how a FFD issue could impact a fission product barrier (no discernible trend or impact) and **NO** is appropriate.

5. ☐ YES ☐ NO Result in an impact in defense-in-depth capability? Examples include:
   a. Strengthen balance of accident prevention and mitigation
   b. Reduce reliance on programmatic activities
   c. Reduce probability of common-cause failures

Justification: Assume **NO** since there is no discernible trend from the proposed action which would impact defense-in-depth capability not already captured in the first 4 screening questions.

Thus the evaluation would continue to Step 2.

Step 2: Screening on Minimal Impact

- To be more than minimal the effect of a proposed activity must be discernible and attributable to the proposed activity in order to exceed the more than minimal decrease standard.
- An impact of delta CDF and LERF of less than 1E-6/1E-7 per year respectively is minimal
- Industry and NRC have comprehensive programs to monitor plant performance (Maintenance Rule, MSPI, ROP, accident precursor program, and others), and to date FFD issues have not been an issue. Further these programs are able to provide for corrective action before a safety significant trend could occur in the future

Industry Costs and Reference Risk Level:

A given 10-year per unit implementation cost affects how the issue would stack up against other projects:

10-yr Cost per Unit	CDF Reduction Equivalent
$100k	~ 3 x 10^{-7} /yr (VL)
$300k	~ 10^{-6} /yr (VL/L)
$1 million	~ 3 x 10^{-6} (L)

Step 3A: Pair-Wise Comparison to RCP Seal Improvement Project

Matrix by Current Risk and Potential Impact

UB is upper bound of the risk range; Mid is "mid-range" (0.3 times UB); LB is factor of 10 lower than UB

Current Risk associated with Issue *Note: Address the specific issue first; then assess impacts on other risk contributors potentially impacted*	**Potential Impact of Action (Reduction in Risk)**					
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