

# NFPA 805 MONITORING

## TOPICS

- ◆ Current Regulatory Concerns
- ◆ Relationship to the Maintenance Rule
- ◆ Basis for use of Maintenance Rule
- ◆ Possible Path Forward
- ◆ Conclusion & Questions



# NFPA 805 MONITORING DEFINITION

- ◆ 2.6\* Monitoring.
  - A monitoring program shall be established to ensure that the availability and reliability of the fire protection systems and features are maintained and to assess the performance of the fire protection program in meeting the performance criteria. Monitoring shall ensure that the assumptions in the engineering analysis remain valid.
- ◆ 2.6.1 Availability, Reliability, and Performance Levels.
  - Acceptable levels of availability, reliability, and performance shall be established.
- ◆ 2.6.2 Monitoring Availability, Reliability, and Performance.
  - Methods to monitor availability, reliability, and performance shall be established. The methods shall consider the plant operating experience and industry operating experience.
- ◆ 2.6.3 Corrective Action.
  - If the established levels of availability, reliability, or performance are not met, appropriate corrective actions to return to the established levels shall be implemented. Monitoring shall be continued to ensure that the corrective actions are effective.



# CURRENT REGULATORY CONCERNS



# NFPA 805 MONITORING REGULATORY BACKGROUND

- ◆ FAQ 10-0059 was written
  - Rev 5 was agreed upon with NRC (March 2012)
- ◆ LARs prepared using FAQ 10-0059 approach
- ◆ Licensees received/responded to generic RAI on Monitoring
- ◆ Majority of NFPA 805 monitoring programs were performed using FAQ 10-0059 in similar fashion
- ◆ SEs issued based of FAQ 10-0059 approach
- ◆ Findings on monitoring during Triennial Inspections (2015-2016)



# MONITORING FINDINGS

- ◆ 2 sites currently have findings related to Maintenance Rule Unavailability being higher than the Fire PRA test and maintenance value.
- ◆ Findings based on wording in NFPA 805 and the FAQ
- ◆ NFPA 805:
  - 2.6\* Monitoring.  
A monitoring program shall be established to ensure that the availability and reliability of the fire protection systems and features are maintained and to assess the performance of the fire protection program in meeting the performance criteria. *Monitoring shall ensure that the assumptions in the engineering analysis remain valid.*
- ◆ From FAQ 10-0059 Rev 5:
  - 3. Action level threshold – When establishing the action level threshold for reliability and availability, *the action level should be no lower than the fire PRA assumptions.*



# DEFINITION OF MONITORING

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# BASIC ELEMENTS OF A MONITORING PROGRAM

- ◆ Determine the SSCs and programmatic elements that are integral to your NFPA 805 Fire Protection Program
- ◆ Ensure a process exists to track the performance of the SSCs
- ◆ Determine which of these have a significant risk impact
- ◆ Ensure the tracking and trending processes are commensurate with the risk impact
- ◆ Ensure adverse trends in the SSCs are documented
- ◆ Ensure a process is in place to reverse adverse trends



# WHAT MONITORING DOES NOT DO

- ◆ Determine functional failure criteria
- ◆ Determine required compensatory measures
- ◆ Require condition reports for individual failures
- ◆ Set Surveillance Frequencies





# RELATIONSHIP TO THE MAINTENANCE RULE



# NFPA 805 MONITORING (APPENDIX A)

- ◆ A.2.6 ***The maintenance rule is an example of an existing availability and reliability program.*** A program requiring periodic self-assessments is an example of a method for monitoring overall effectiveness or performance of the fire protection program. Regulation Guide 1.174, “An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant Specific Changes to the Licensing Basis,” provides further guidance on acceptable monitoring programs.

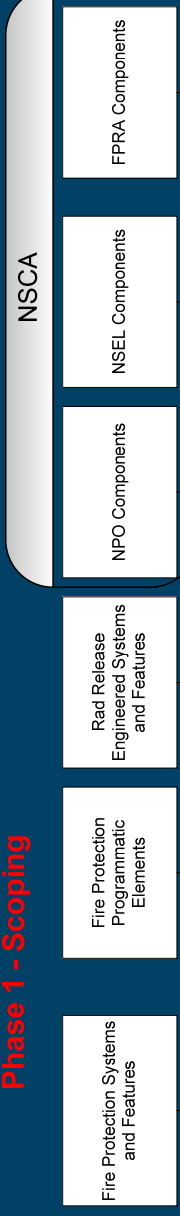
Assumptions that are not subject to change do not need to be monitored. The level of monitoring of assumptions should be commensurate with their risk significance.



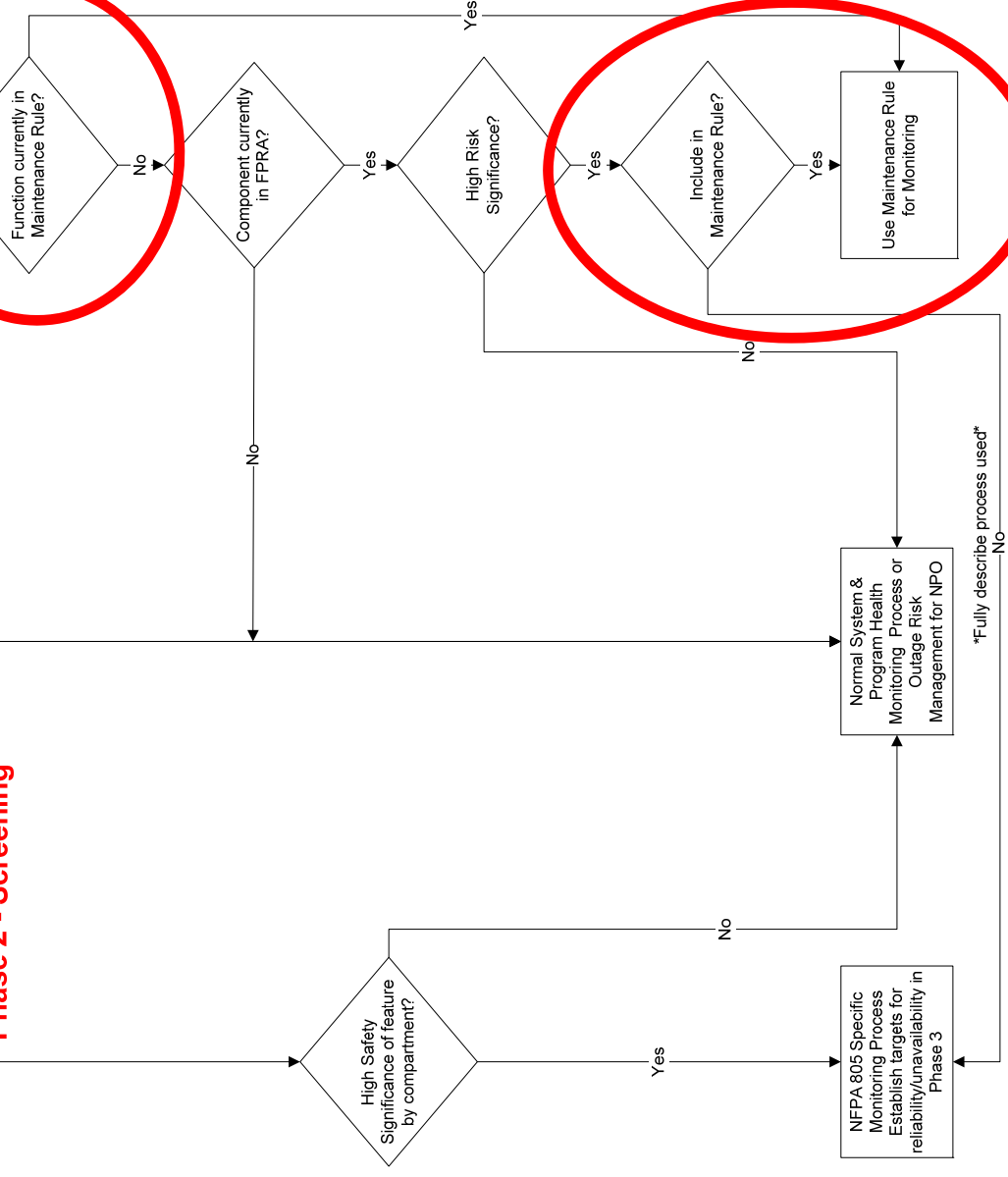
# FAQ 10-0059 REV 5

- ◆ The ***Maintenance Rule (10 CFR 50.65) and Regulatory Guide 1.174 are provided as examples in NFPA 805 Section A.2.6 of acceptable monitoring programs.*** However, the appendices of NFPA-805 are not part of the 50.48(c) rule and flexibility is provided to allow plant-specific processes to be established for performance monitoring.
- ◆ The majority of NSCA SSCs relied upon to ensure post-fire nuclear safety performance criteria is met is equipment that is important for plant risk and mitigation of the consequences of design basis accidents. Therefore, most NSCA equipment important to fire risk will be subjected to inspection, testing, and performance monitoring as part of the ***Maintenance Rule process*** and subjected to a variety of plant controls and processes.
- ◆ NSCA equipment may already be ***appropriately monitored by the Maintenance Rule.***

## Phase 1 - Scoping



## Phase 2 - Screening



# REQUEST FOR ADDITIONAL INFORMATION (RAI) EXAMPLES

- ◆ a. A description of the process by which systems, structures, and components (SSCs) will be identified for inclusion in the NFPA 805 monitoring program, including the approach to be applied to any fire protection SSCs that are already included within the scope of the Maintenance Rule program.
  - Per the guidance of FAQ 10-0059, those SSC's already within the scope of the Maintenance Rule per 10 CFR 50.65 **will be reviewed to ensure that the monitored function under the Maintenance Rule adequately bounds the NFPA 805 credited function of the SSC.** For those cases where the function is not bounded, a new Maintenance Rule function with appropriate performance goals will be created to accommodate the needs of the NFPA 805 Monitoring program.
  - When the NFPA 805 monitoring program determines the need to monitor structures, systems, and components (SSCs) for reliability and/or unavailability that are currently monitored under the Maintenance Rule Program, **the Maintenance Rule Program monitoring will be credited for the NFPA 805 monitoring requirements.** In these cases, the NFPA 805 monitoring program will include steps to ensure that the maintenance rule monitoring appropriately bounds the assumptions of NFPA 805, including risk significance and function. Adjustment will be made as required to the Maintenance Rule monitoring to bound the NFPA 805 assumptions as well as the maintenance rule assumptions.



# BASIS FOR USE OF MAINTENANCE RULE



# INDUSTRY PERSPECTIVE

- ◆ Goal and Intent of Maintenance Rule was the same as NFPA 805 Monitoring

“In 10 CFR 50.65(a)(1), the NRC requires that power reactor licensees **monitor** the performance or condition of SSCs against licensee-established goals in a manner sufficient to provide reasonable assurance that such SSCs are capable of fulfilling their intended functions. Such goals are to be established **commensurate with safety** and, where practical, take into account industrywide operating experience. When the performance or condition of an SSC does not meet established goals, appropriate **corrective action must be taken.**” *Reg Guide 1.160*
- ◆ NSCA and FPRA equipment currently considered risk significant in Maintenance Rule have the appropriate level of tracking to ensure adverse trends were identified and corrective actions were in place to improve performance once adverse trends were identified.

# SCREENING

- ◆ Risk Screening in NFPA 805 is based on the risk importance of components in the Fire PRA model.
  - The Maintenance Rule approach when using the Fire PRA creates a new set of High Safety Significant equipment requiring monitoring
  - These HSS functions must be compared to the equivalent risk significant functions in Maintenance Rule
  - Any equipment not currently Risk Significant in Maintenance Rule requires additional NFPA 805 Monitoring

*“HSS NSCA SSCs not currently monitored in Maintenance Rule should be included in either the Maintenance Rule or the NFPA 805 monitoring program.” FAQ 10-0059 Rev 5*





# PERFORMANCE CRITERIA

- ◆ Fire PRA is built upon the internal events framework
  - NSCA equipment is taken directly from the internal events model
  - NSCA failure rates and unavailability values are not altered in the Fire PRA model
- ◆ Maintenance Rule goals and performance criteria are based on the failure rates and unavailability values that are identical to the ones in the Fire PRA
  - Creation of performance criteria in Maintenance Rule utilizes the same base assumptions as the NFPA 805 Monitoring Risk Target Values
- ◆ Although the risk significance of specific equipment may differ between IEPRA and Fire PRA, the underlying availability and reliability values and assumptions are the same



# PERFORMANCE CRITERIA

## FAILURE CRITERIA DISCUSSION IN IMPLEMENTING DOCUMENTS

### ◆ FAQ 10-0059 Rev 5

“**Failure criteria** are established by an expert panel or evaluation based on the required fire protection and nuclear safety capability SSCs and programmatic elements **assumed level of performance in the supporting analyses.**”

### ◆ NUMARC 93-01

“Specific risk significant SSC **performance criteria** should consider plant-specific performance and, where practical, industrywide operating experience. Performance criteria for risk significant SSCs should be established to assure that reliability and availability **assumptions used in the plant-specific PRA, IPE, IPEEE, or other risk determining analysis are maintained** or adjusted when determined necessary by the utility.”

# MAINTENANCE RULE PROCESS

- ◆ Risk Informed
  - Utilizes an expert panel approach
  - Plant Operating Experience
  - Industry Operating Experience
- ◆ Final values used as Performance Criteria may not be specific one-to-one correlation to PRA data
  - Based on multiple cycles of data
  - Ensures the assumed average performance is maintained
  - Intended to determine adverse long term trends – not individual extended maintenance or spikes in failure data

## “2.6.2 Monitoring Availability, Reliability, and Performance.

*Methods to monitor availability, reliability, and performance shall be established. The methods shall consider the plant operating experience and industry operating experience.” NFPA 805*

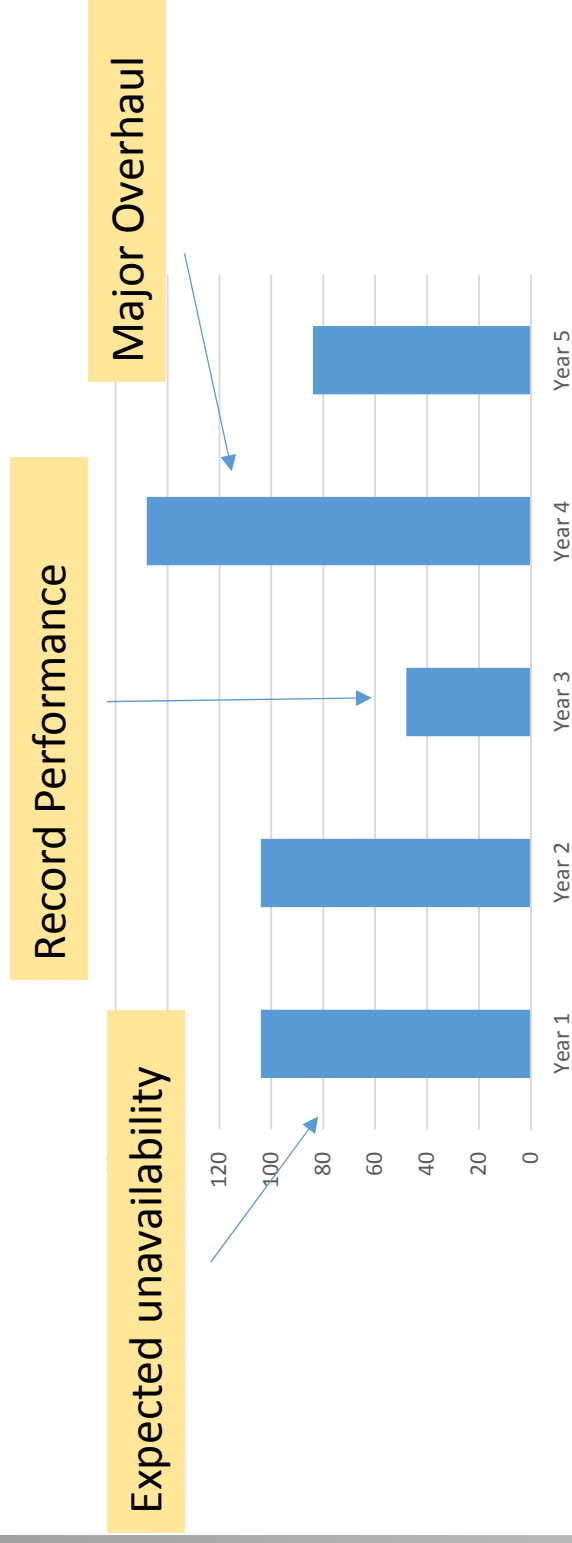


# MAINTENANCE RULE DISCUSSION - UNAVAILABILITY

- ◆ PRA Models should be designed to represent the average “as-built, as operated” plant.
  - PRA Models typically take multiple cycles of unavailability data to create the target values.
- ◆ Use of an average value over multiple cycles removes the conservative bias from:
  - Extended planned major overhauls
  - Extended unavailability due to corrected issues
- ◆ The average values in the Fire PRA should improve over time with improved plant performance or decline given poor performance of equipment – match the as-operated plant
- ◆ Maintenance Rule Unavailability targets are based on:
  - Expected planned activities in a year
  - Industry and operator experience with equipment
  - Risk insights

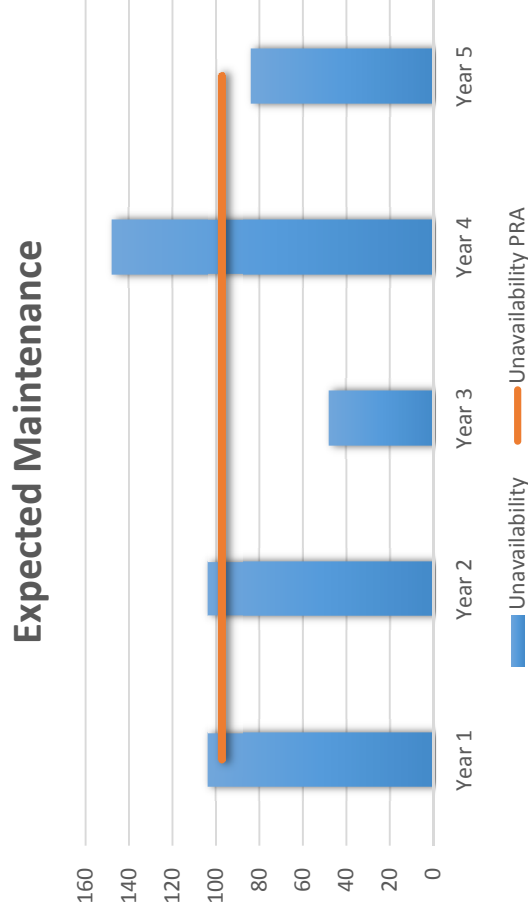
# MAINTENANCE RULE DISCUSSION – UNAVAILABILITY EXAMPLE

- ◆ Plant Equipment has monthly required maintenance / yearly required major surveillances
  - Generally the monthly maintenance takes an 8 hour shift and the yearly surveillance takes 2 shifts
- ◆ A major overhaul is required due to a found failure
- ◆ Over a 5 year period – the unavailability data is shown below



# MAINTENANCE RULE DISCUSSION – UNAVAILABILITY EXAMPLE

- ◆ The PRA takes the data from all 5 years and creates an average yearly unavailability
- ◆ Based on the data the PRA would have an unavailability of 1.13E-2 (98 hours)
- ◆ This correlates to a value LESS than the expected maintenance practice at the site which would have 1.20E-2 (104 hours)



# MAINTENANCE RULE DISCUSSION - UNAVAILABILITY

- ◆ Maintenance rule is intended to find adverse trends and not penalize the site for expected maintenance.
  - The expected unavailability at the plant is 104 hours in this case.
  - An adverse trend is not expected unless the unavailability for the year is GREATER than 104 hours.
- ◆ The Expert Panel would use the information from the PRA and inform it with the known unavailability of the plant.
- ◆ The Expert Panel could set allowable per year value of 104 hours based on expected maintenance practices.
  - A PRA sensitivity could be performed if desired to show impact of using 104 hours on the PRA.

*As maintenance practices continue to show improved times – PRA value would continue to improve and the expert panel could choose to lower the criteria based on PRA and plant experience.*

# MAINTENANCE RULE EXAMPLE - RELIABILITY

- ◆ PRA data is based on industry documents and informed by plant specific data as appropriate.
- ◆ PRA model data is built on actual distributions of data of which the mean is typically documented in the model.
- ◆ The maintenance rule performance criteria is intended to show adverse trends in data.
- ◆ Typically for reliability values the performance criteria based on a 90% threshold of the distribution in the PRA model.
- ◆ Reliability criteria for risk significant equipment is generally  $<2$  FF
  - In many cases there is no numeric difference in using the MEAN value vs the 90% when determining the actual number of FF.

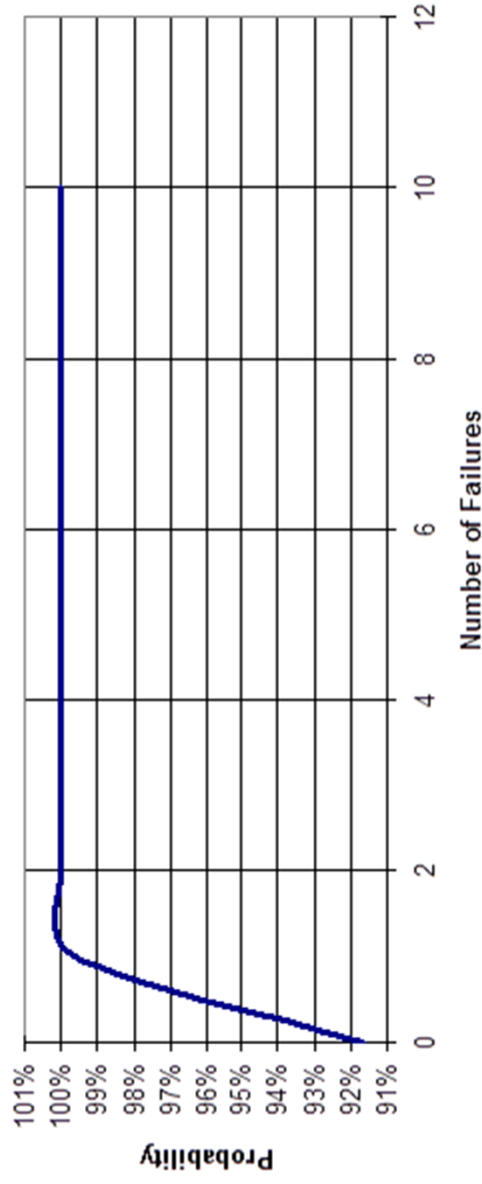




# MAINTENANCE RULE EXAMPLE - RELIABILITY

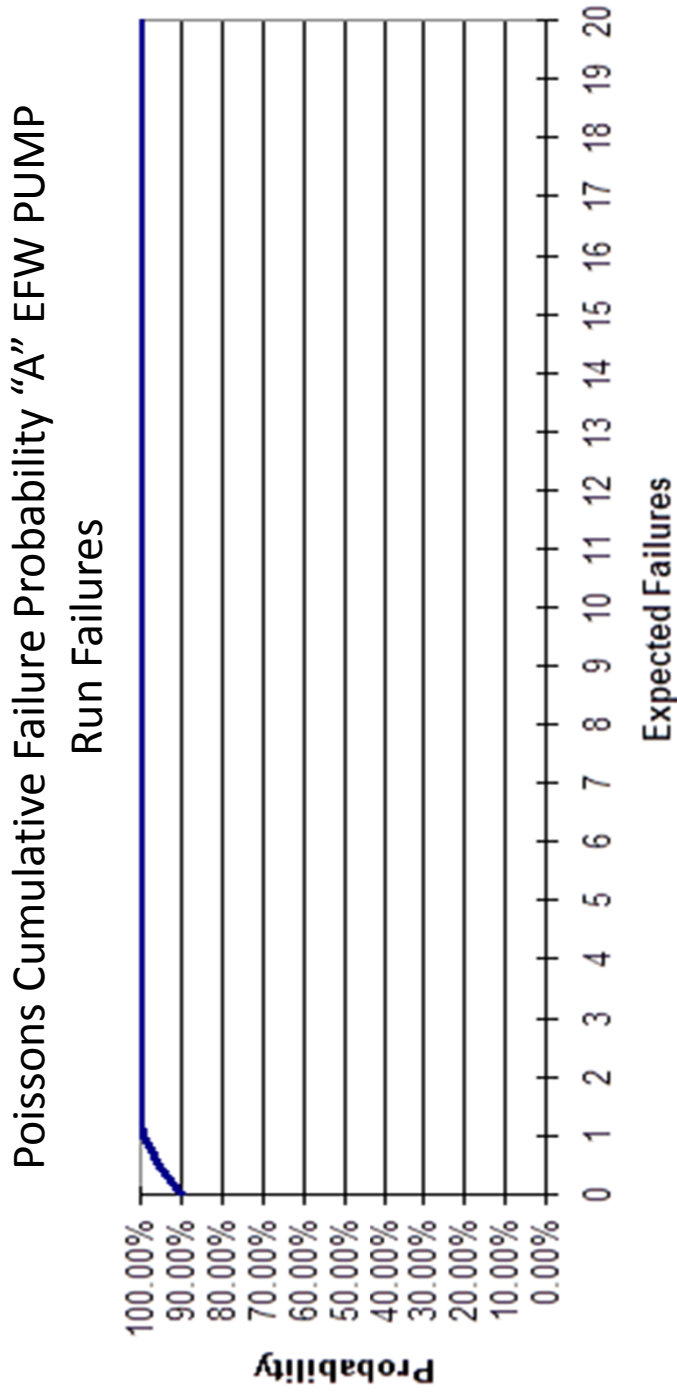
- ◆ Using a Binomial distribution for the demand failures provides the following cumulative probability curve for an EFW pump.
- ◆ A cumulative probability refers to the probability that the value of a random variable falls within a specified range. The distribution represents a 100% likelihood that the random number of EFW pump demand failures will be  $\leq 2$  failures based on this distribution.

Cumulative Failure Probability “A” EFW PUMP  
Failures/Demand



# MAINTENANCE RULE EXAMPLE

- ◆ Using the Poisson distribution for the run failures provides the following cumulative probability curve.



# MAINTENANCE RULE EXAMPLE

- ◆ Reviewing the data, it can be concluded that the 90% cumulative probability of a demand failure or a run failure for Train “A” is 1 demand failure and 1 run failure per cycle of operation.
  - This analysis would predict a 90% probability of at least 2 failures of the “A” train of EFW per cycle of operation.
- ◆ Therefore, 2 failures per cycle would be recommended to the expert pane as the reliability performance criteria for the Maintenance Rule.



# MAINTENANCE RULE EXAMPLE

- ◆ This 90% threshold is reasonable in relation to evaluating the performance of the system and protects the assumptions (the distributions) in the PRA.
- ◆ The use of the 90% threshold in establishing the performance criteria allows for the determination that a system is operating outside the bounds of the PRA assumptions and actions are required to improve performance.
- ◆ The use of any criteria less than 90%, although providing a more accurate depiction of the mean value used in the PRA model, would not add any value to the evaluation of the system performance and adds no additional value for ensuring that the assumptions in the PRA remain valid.

# BASIS FOR USE OF MAINTENANCE RULE

- ◆ Similar regulatory goal – ensuring risk significant SSC performance is tracked and actions are taken when adverse trends are noted
- ◆ Same PRA data used in Maintenance Rule PRA as in NFPA 805 monitoring for NSCA SSCs
- ◆ Maintenance Rule processes are built upon plant knowledge and industry experience
- ◆ Maintenance Rule processes are set to ensure the overall assumptions in the PRA remain valid



# BASIS FOR USE OF MAINTENANCE RULE

- ◆ The charts demonstrate that use of the mean values from the PRA model would most likely set the performance criteria at zero failures.
- ◆ Zero failures is not an appropriate criteria for monitoring (i.e. some random failures are to be expected)
  - Not adequate for ensuring the assumptions in the model are maintained.



# CURRENT REGULATORY CONCERNS



# MONITORING FINDINGS

- ◆ 2 sites currently have findings related to Maintenance Rule Unavailability being higher than the Fire PRA test and maintenance value.

*Monitoring shall ensure that the assumptions in the engineering analysis remain valid.*

Monitoring program shall be established to ensure that the availability and reliability of the fire protection systems and features are maintained and to assess the performance of the fire protection program in meeting the performance criteria. *Monitoring shall ensure that the assumptions in the engineering analysis remain valid.*

*the action level should be no lower than the fire PRA assumptions.*

*lower than the fire PRA assumptions.*



# NFPA 805 WORDING

*Monitoring shall ensure that the assumptions in the engineering analysis remain valid.*

- ◆ Taken beyond original intent of reviewing assumptions in analysis
- ◆ Assumptions are reviewed as part of monitoring
  - Data in the PRA is not considered an assumption
  - Monitoring looks at assumptions related to transient combustibles, hot work, fire brigade, etc.
  - These assumptions are then reviewed for monitoring

## Assumptions Example

- ◆ PRA assumes certain electrical cabinets are sealed –
  - Monitoring program would ensure that there is a program to track and trend failures of cabinets to be sealed

# FAQ WORDING

Action level threshold – When establishing the action level threshold for reliability and availability, *the action level should be no lower than the fire PRA assumptions.*

- ◆ Statement appears in the beginning of FAQ in the Points of Clarification Discussion and not in the body of the FAQ
- ◆ If read without the entire FAQ process, it can be taken out of context of the overall FAQ
- ◆ The FAQ process was written as a process – which assumed you would only be “establishing action level thresholds” for items not currently in Maintenance Rule



# FAQ WORDING

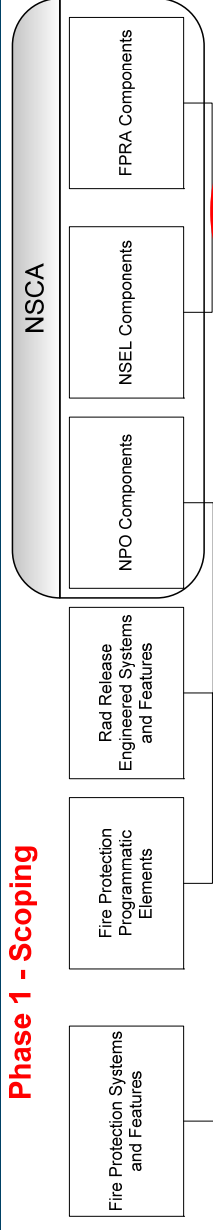
- ◆ Phase 2 Screening states:
  - 2. Nuclear Safety Capability Assessment Equipment\*

NSCA equipment may already be appropriately monitored by the Maintenance Rule. A comparison of NSCA equipment to the SSCs that are monitored in the Maintenance Rule program should be performed to determine what equipment may require additional NFPA 805 Monitoring.
- ◆ Phase 3 Risk Target Value states

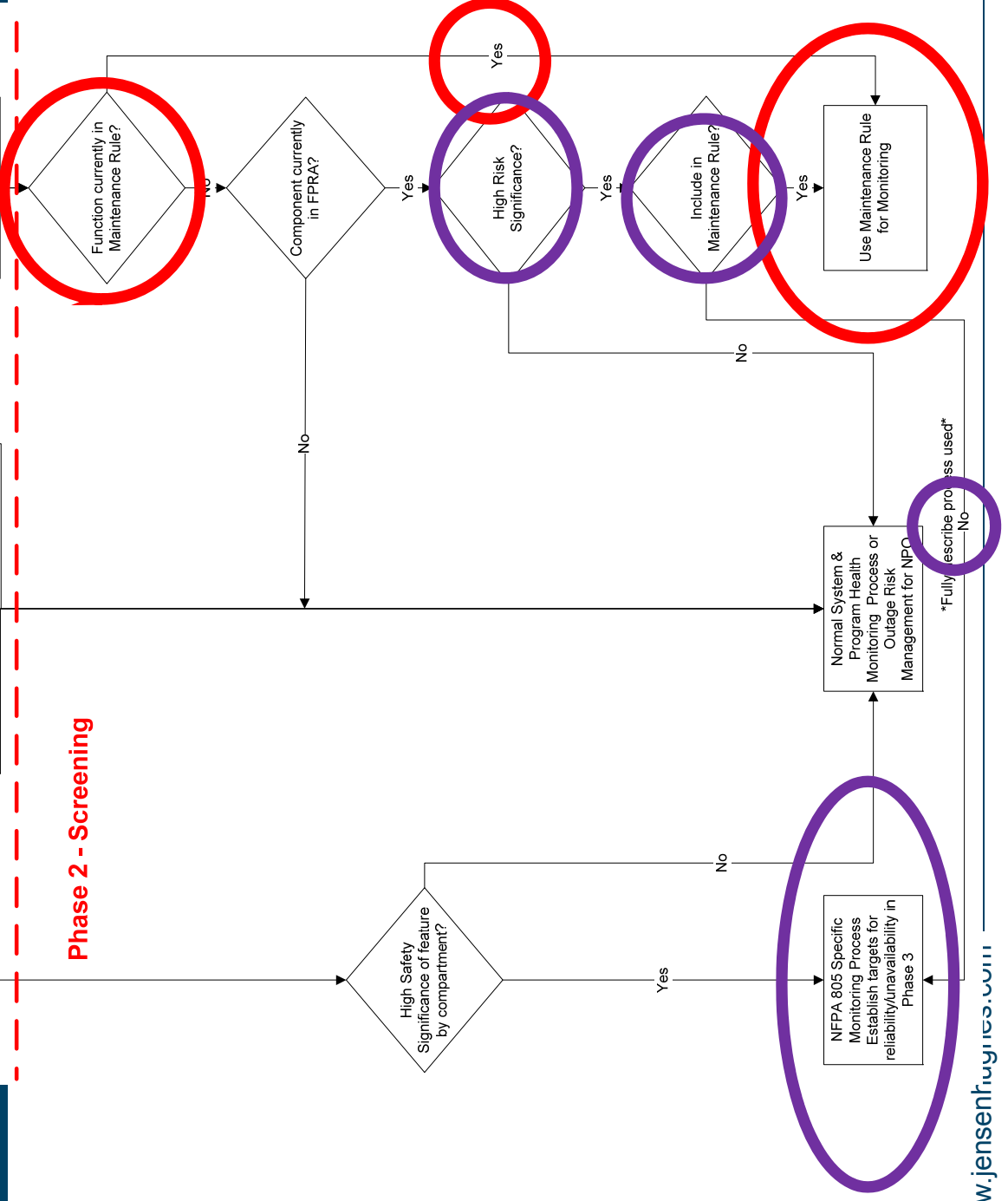
Action level should be developed for the NSCA SSCs that are included in a monitoring program.
- ◆ The process of monitoring would state that Phase 3 did not apply to those items SCREENED in Phase 2 as part of the Maintenance Rule program.
- ◆ This is further clarified in the FAQ flow chart.



## Phase 1 - Scoping



## Phase 2 - Screening



# POSSIBLE PATH FORWARD

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# POSSIBLE PATH FORWARD

- ◆ FAQ 10-0059 Revision
  - Clarify the screening process more clearly
  - Clarify basis for use of the Maintenance Rule
- ◆ Sensitivity Studies/Basis Calculations
  - Provide basis calculation/discussion with Monitoring RTV calculation to show acceptability of Maintenance Rule values
  - Basis may include sensitivity calculations or reference to Maintenance rule basis documents

