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Leveraging Risk Insights for Aging Management Program Implementation

Background and Perspectives

Emma Wong
Principal Technical Leader, EPRI

NRC Public Meeting - Virtual
October 1, 2020

Improvement Opportunity

Enhance Aging Management Program (AMP) implementation
to better meet long-term needs
by delivering an integrated, sustainable framework
emphasizing high impact and high value activities
that reinvest technical knowledge and resources to
better manage aging.

Desired Outcomes – Expected Framework Attributes

- Optimize AMP implementation basis, sample scope, and extent of condition
- Leverage existing industry approaches, programs, and risk insights
- Provide technically justifiable confidence in AMP implementation decisions
- Include a continuous improvement process to enhance AMP effectiveness based upon:
  - Operating experience
  - Research results
  - Industry performance
- Better inform guidance on refining sample populations, implementation of AMP activities focused on risk insights, and program effectiveness reviews

Broad Involvement

Leveraging Risk Insights Team

- Emma Wong, EPRI Project Manager
- Barry Thurston, Exelon Utility Chair
- EPRI, Exelon, PSEG, Southern, Ameren, South Texas Project, Dominion Energy, ENERCON Team

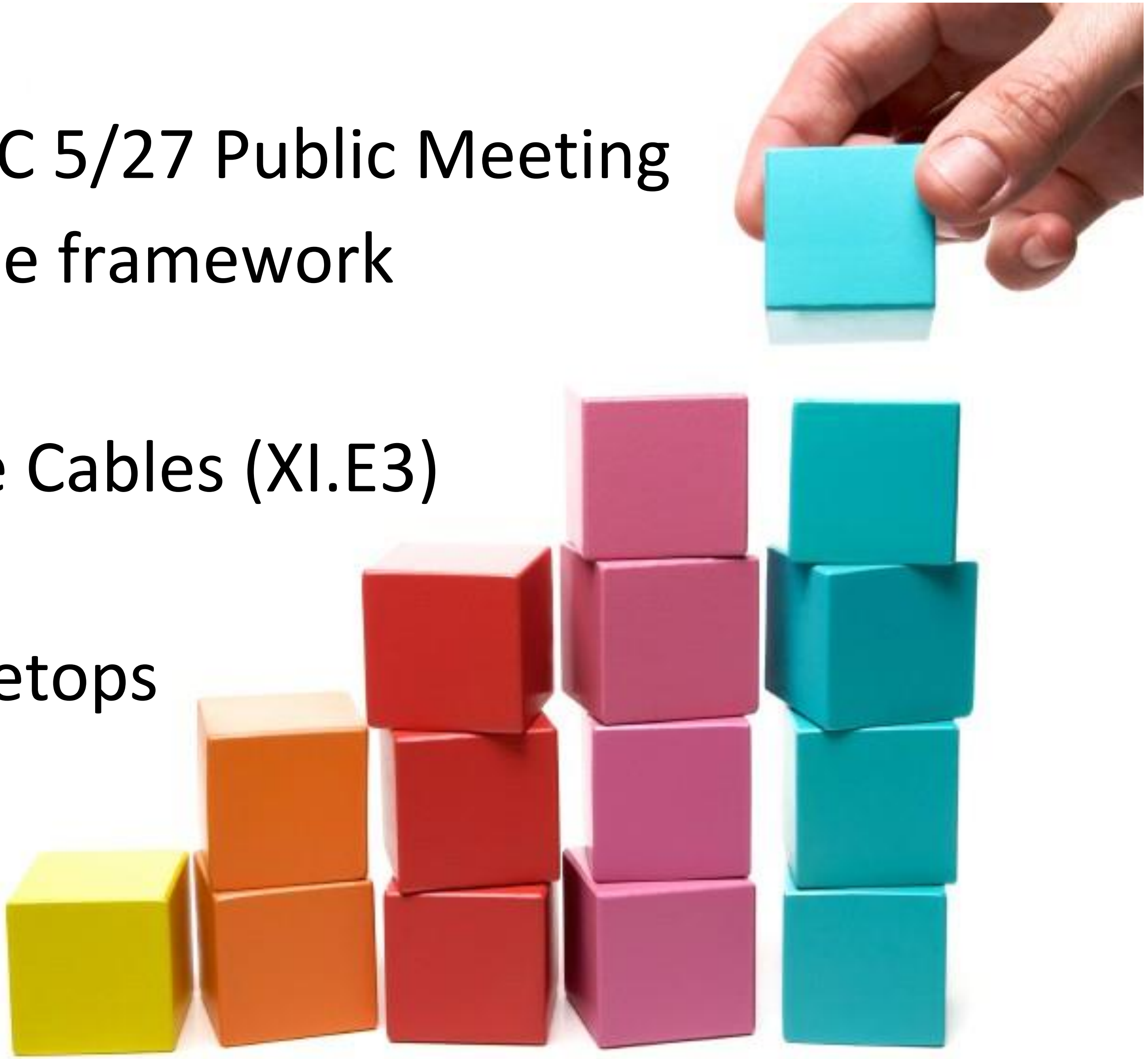
Other Organizations Involved

- Selective Leaching Task Force and other Working Groups
- NEI
- EPRI Cables Users Group
- NEI LRIWG, LREWG, LRMWG

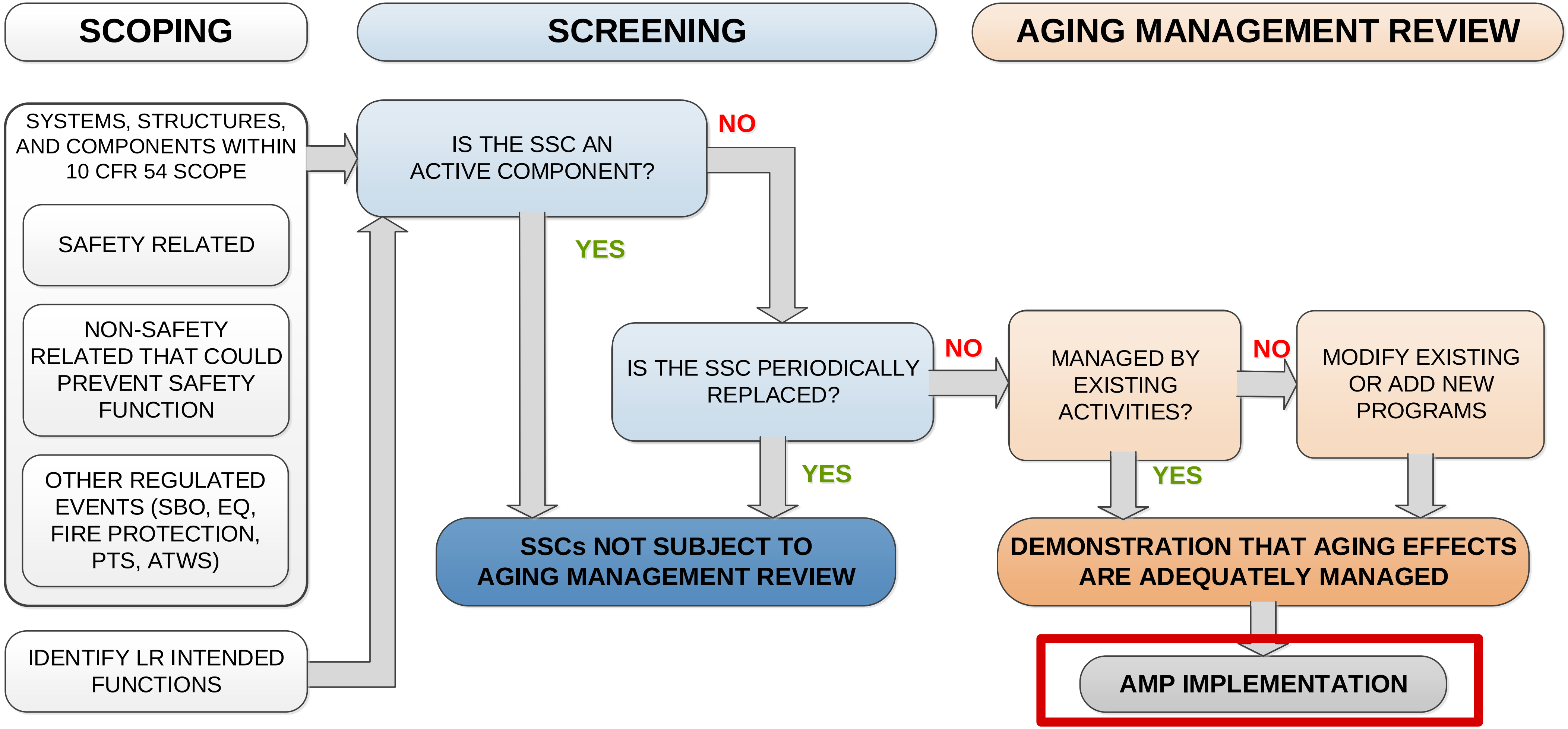
NEI – Nuclear Energy Institute
LRIWG – License Renewal Implementation Working Group
LREWG – License Renewal Electrical Working Group
LRMWG – License Renewal Mechanical Working Group

Progress on the Framework

- Discussed the concept with NRC 5/27 Public Meeting
- Finalized the components of the framework
- Tabletop exercises:
  - Inaccessible Medium Voltage Cables (XI.E3)
  - Selective Leaching (XI.M33)
- Lessons Learned from the Tabletops
- Fall - Pilot Exercises
- 2021 Publish Final Report

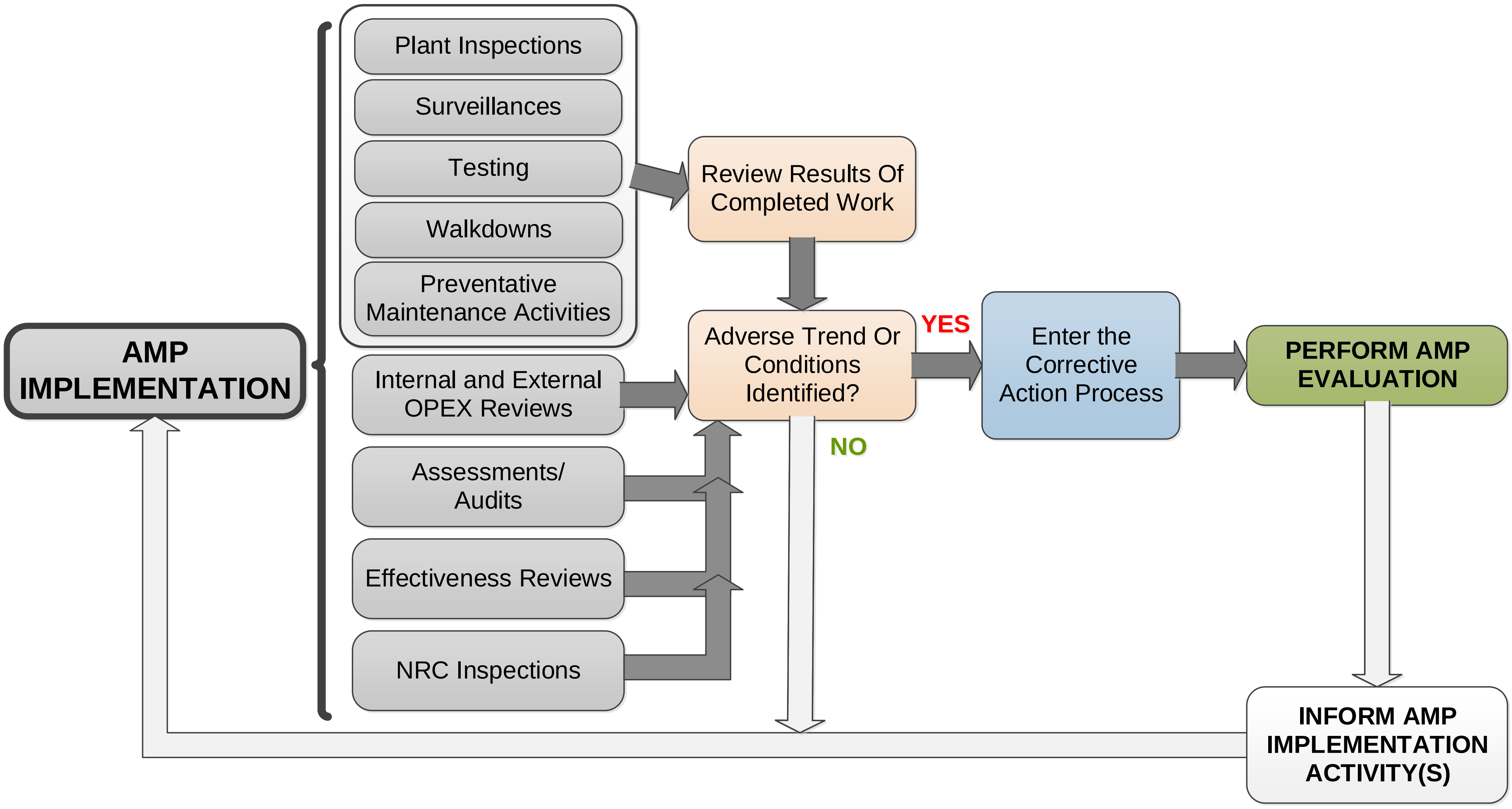


Current Scoping, Screening and Aging Management Review (AMR) Process



Note: ATWS – Anticipated Transient without SCRAM, CFR – Code of Federal Regulations, EQ – Equipment Qualification, PTS – Pressurized Thermal Shock, SBO – Station Blackout

Current AMP Implementation



Leveraging Risk Insights for Aging Management Program Implementation

Framework

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Principal Technical Leader, EPRI

Barry Thurston
Sr. Staff Engineer / Corporate Aging Management Coordinator, Exelon

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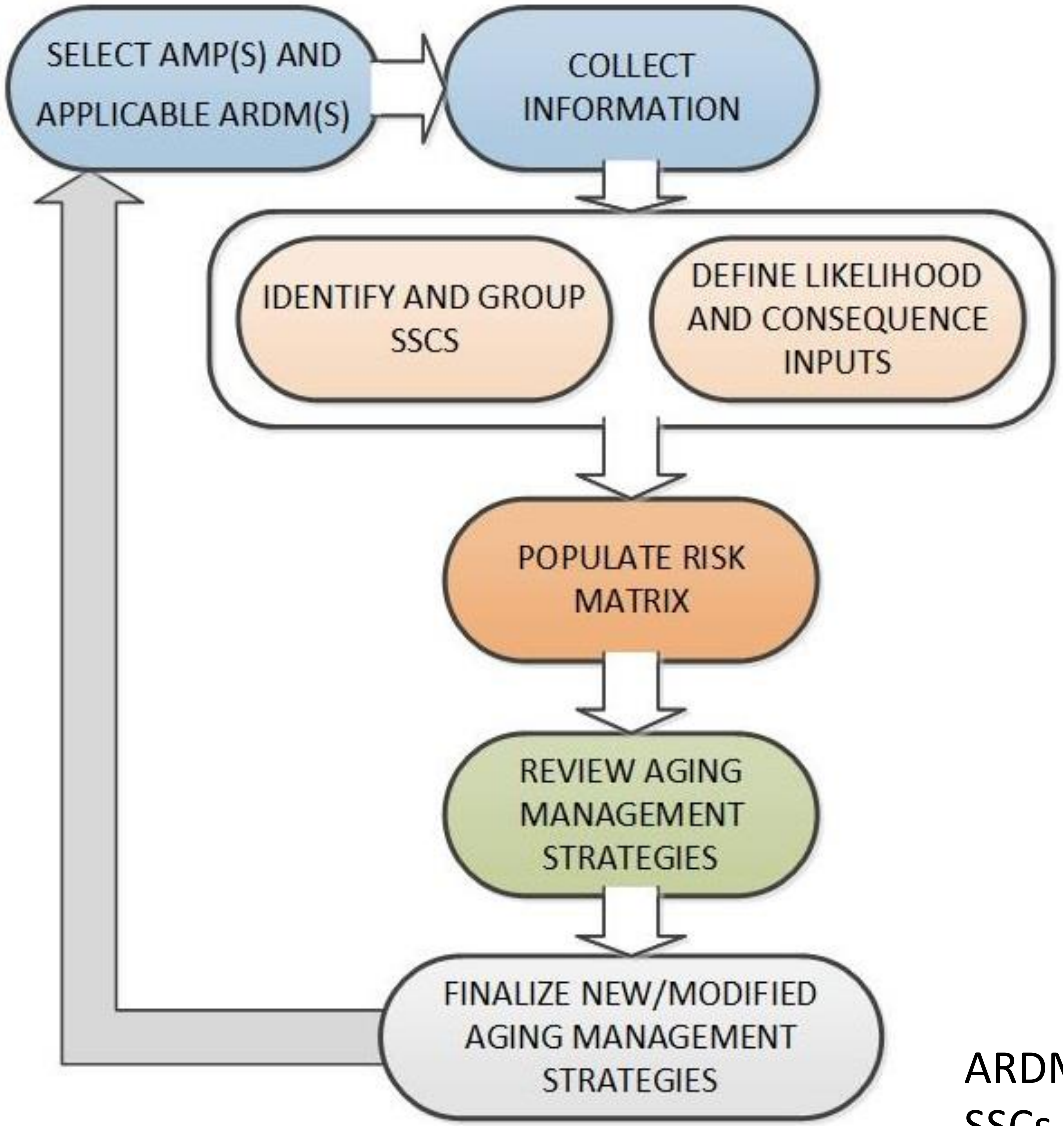
Leveraging Risk Insights Framework Considerations

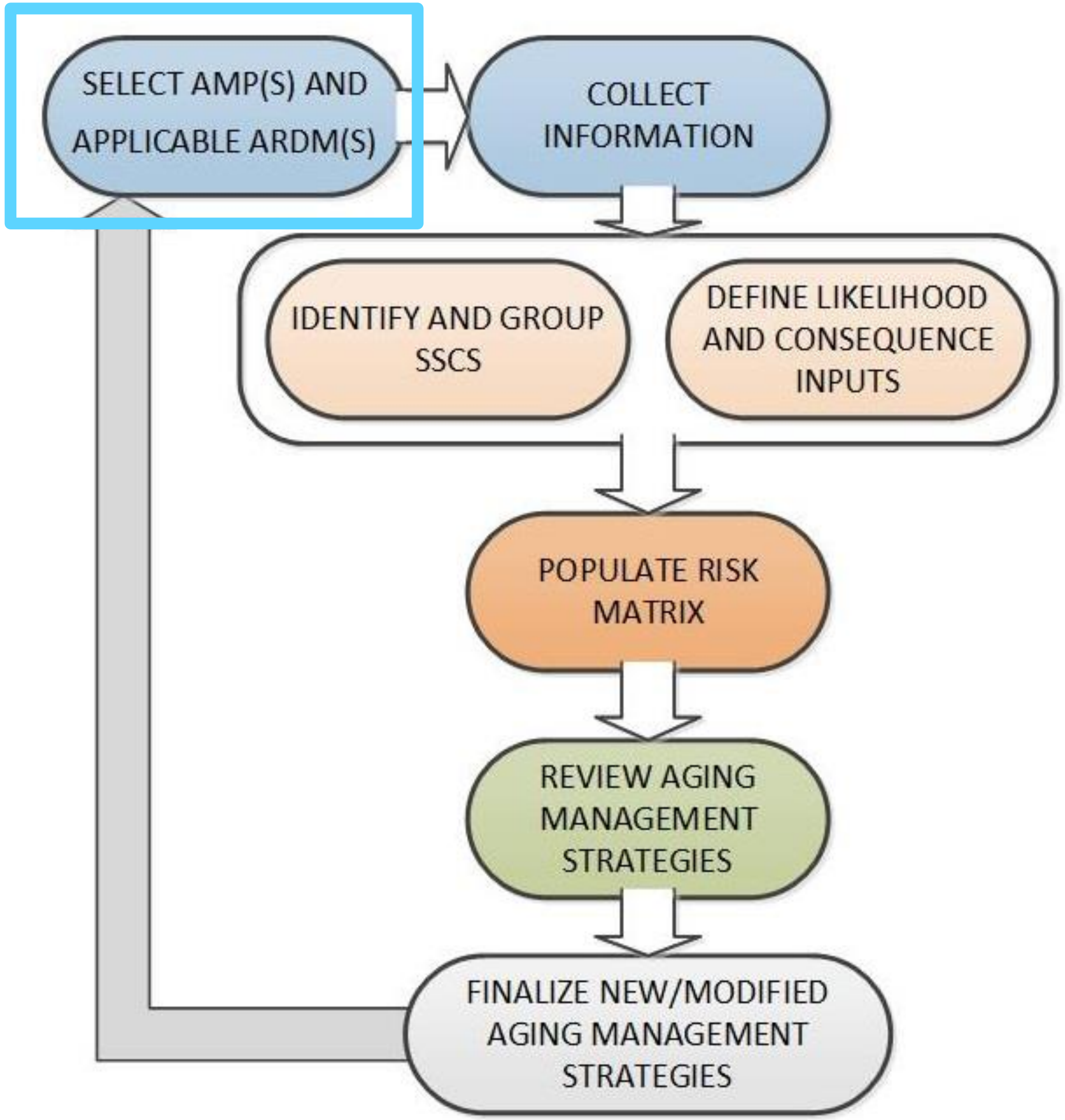
- Focuses resources on leveraging risk insights to inform decisions
- Emphasizes consequences as the basis for actions
- Accounts for likelihoods of consequential outcomes
- Considers risk management strategies to reduce likelihoods and influence consequences
- Guides inspections to refine likelihood models
- Builds component-level understanding of risk
- Reinvests knowledge to enhance AMP implementation activities

Framework Overview



ARDM - Age-Related Degradation Mechanisms
SSCs – Systems, Structures, and Components

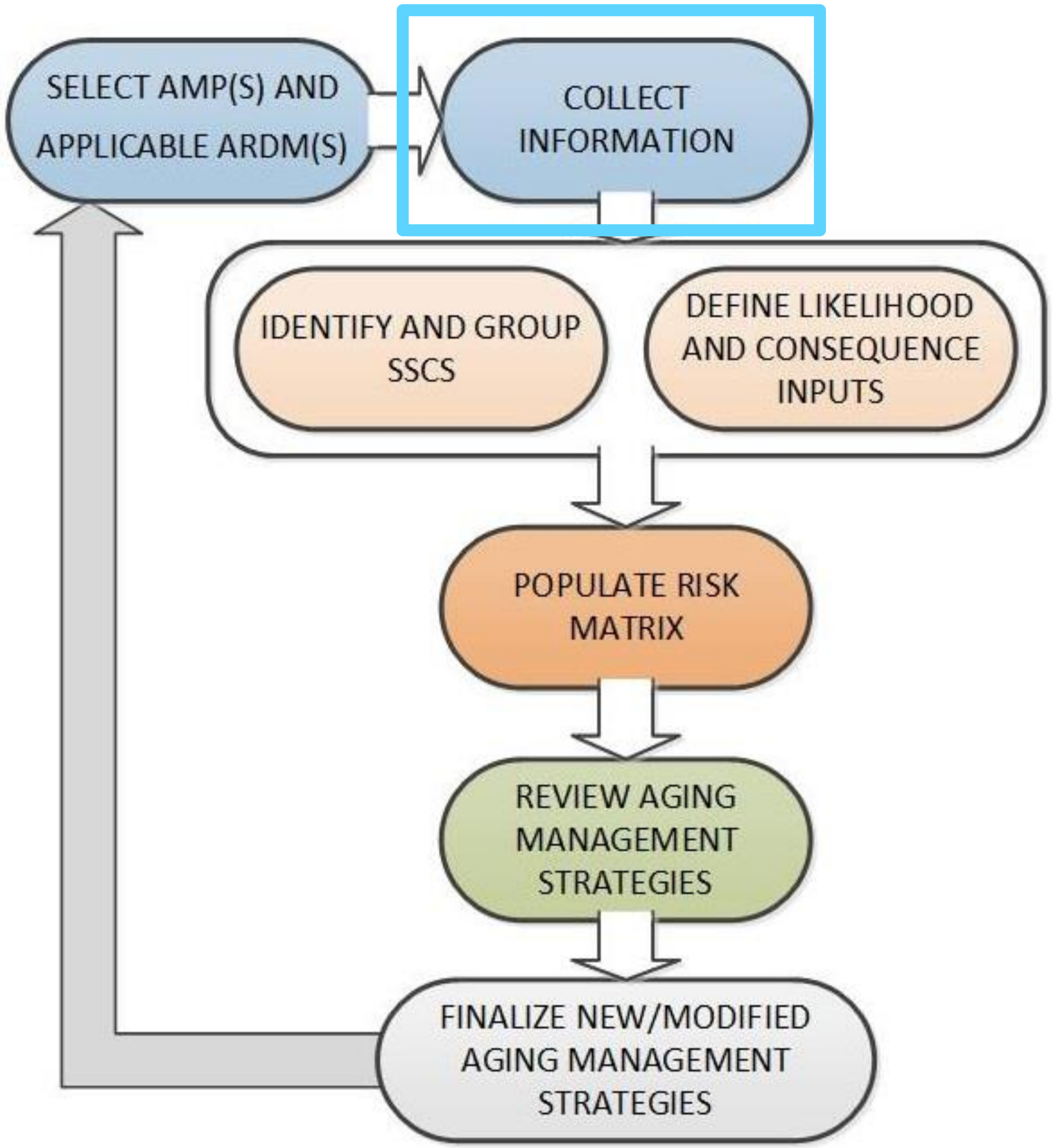
Selecting Candidate AMPs



Considerations

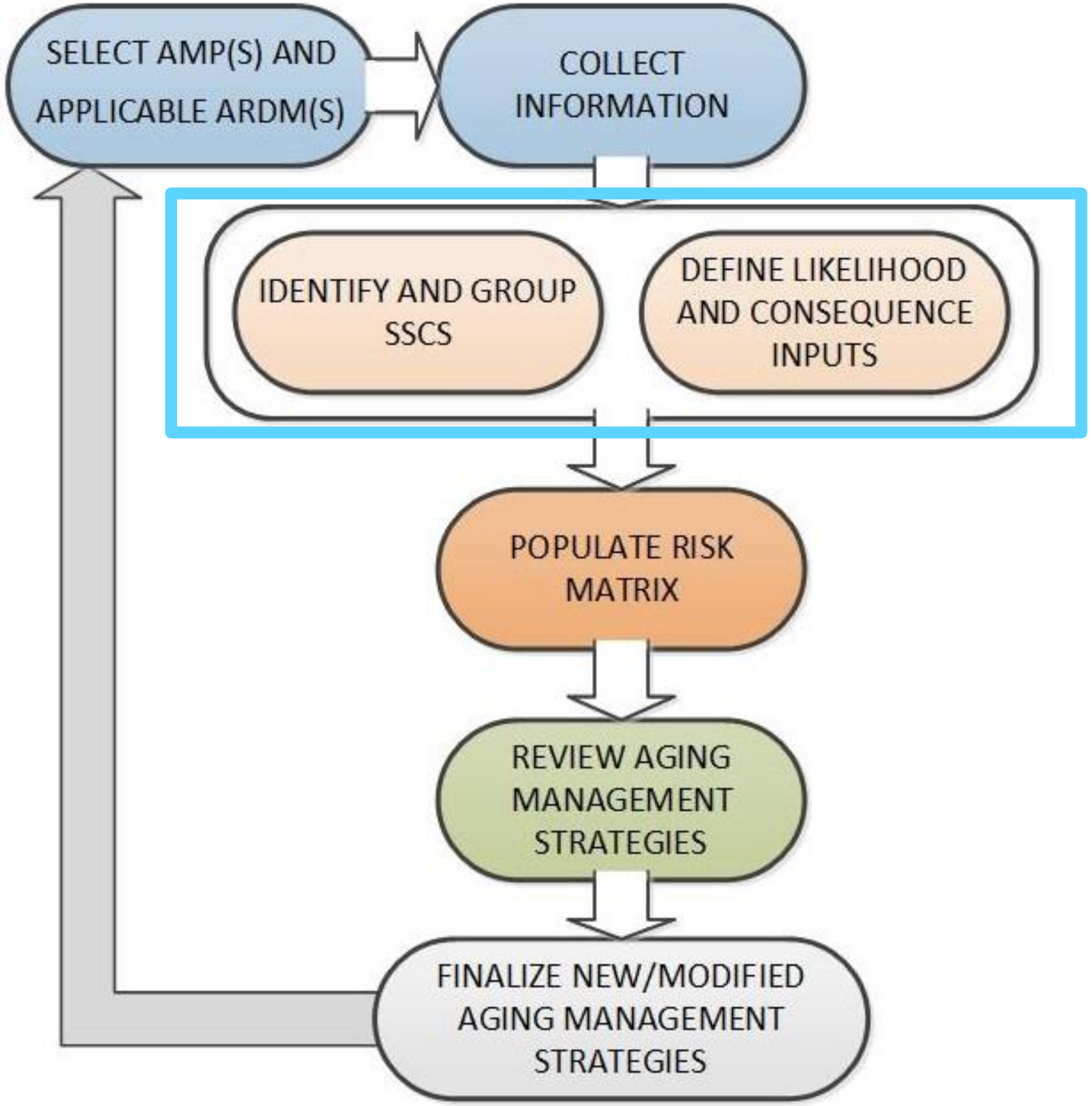
- Maturity of the AMP
- Availability of Industry Guidance
- AMP Implementation Schedule/Period of Extended Operation Entry Status
- Number of SSCs included in the AMP
- AMPs with aging effects that are well understood
- AMP operating experience

Information Needed to Inform the Framework



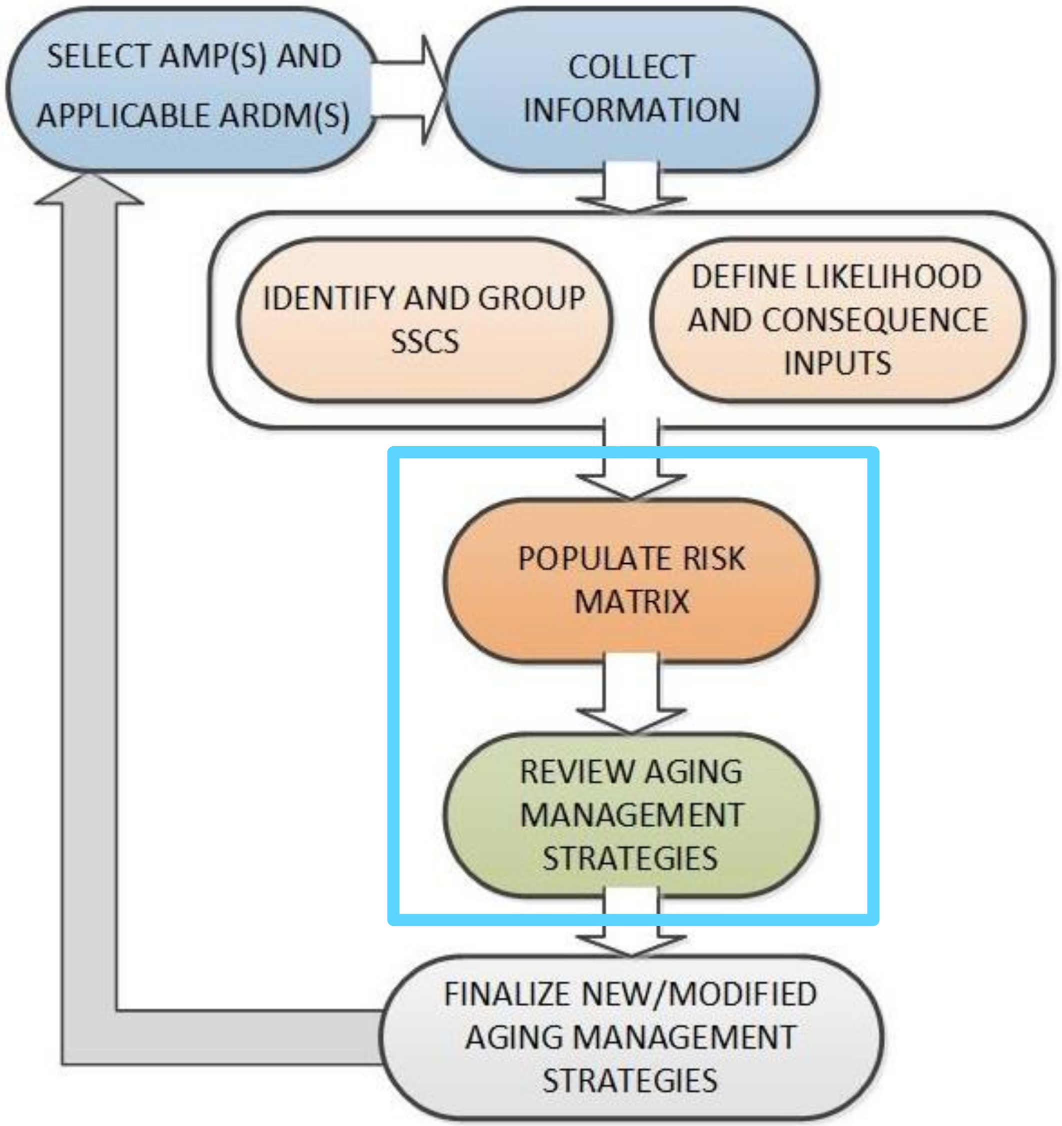
- Plant Specific SSC Information
- Plant Specific Aging Management Information
- Plant Specific Information on Aging Mechanisms
- Plant Specific Risk Insights Information
- Plant Specific Operating Experience
- Other Information Needed (e.g., research)

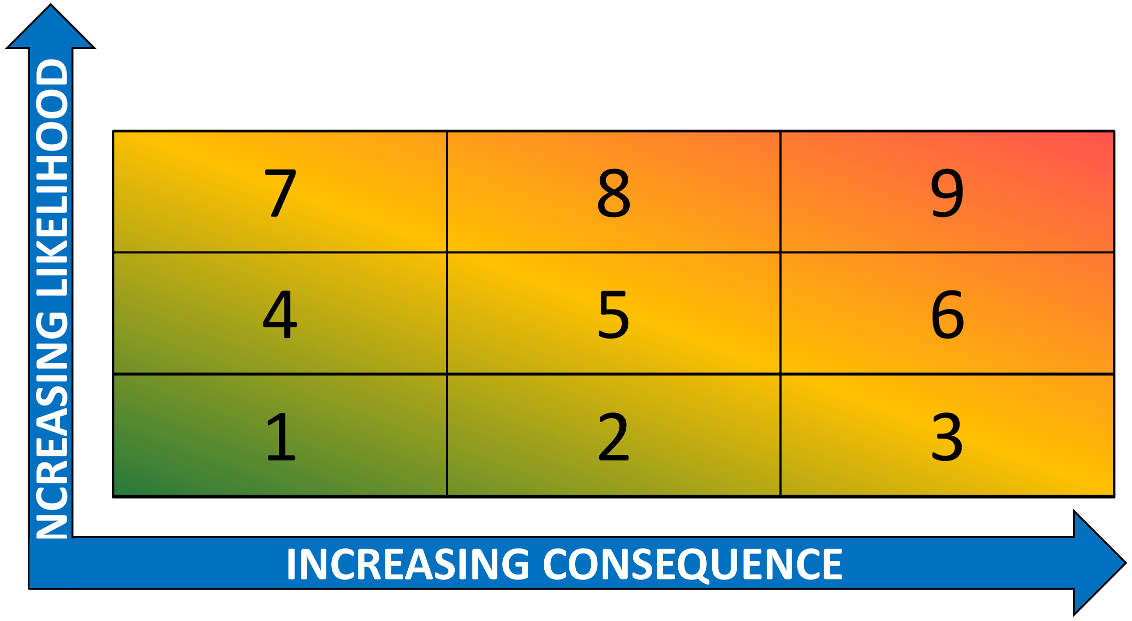
Likelihood and Consequence



- Collect and use operating experience on aging effects to better inform likelihood of occurrence
- Use research results to better inform likelihood of occurrence
- Consequence will be informed by available risk-information and adapted for the purposes of AMPs and aging effects

Risk Matrix



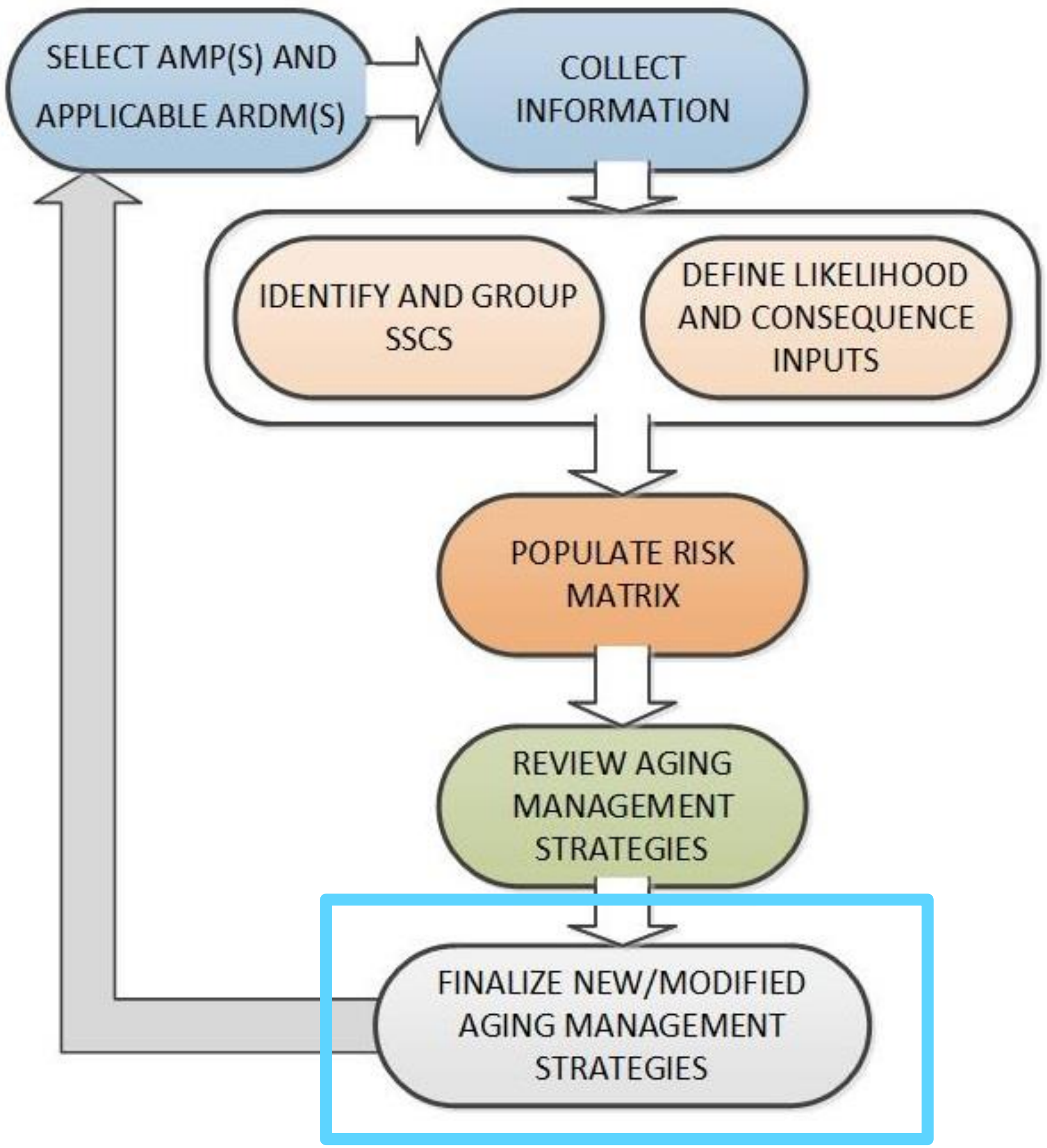


Management Options:

- Proactive Replacement
- Risk Management Strategies
- Inspections of Surrogates

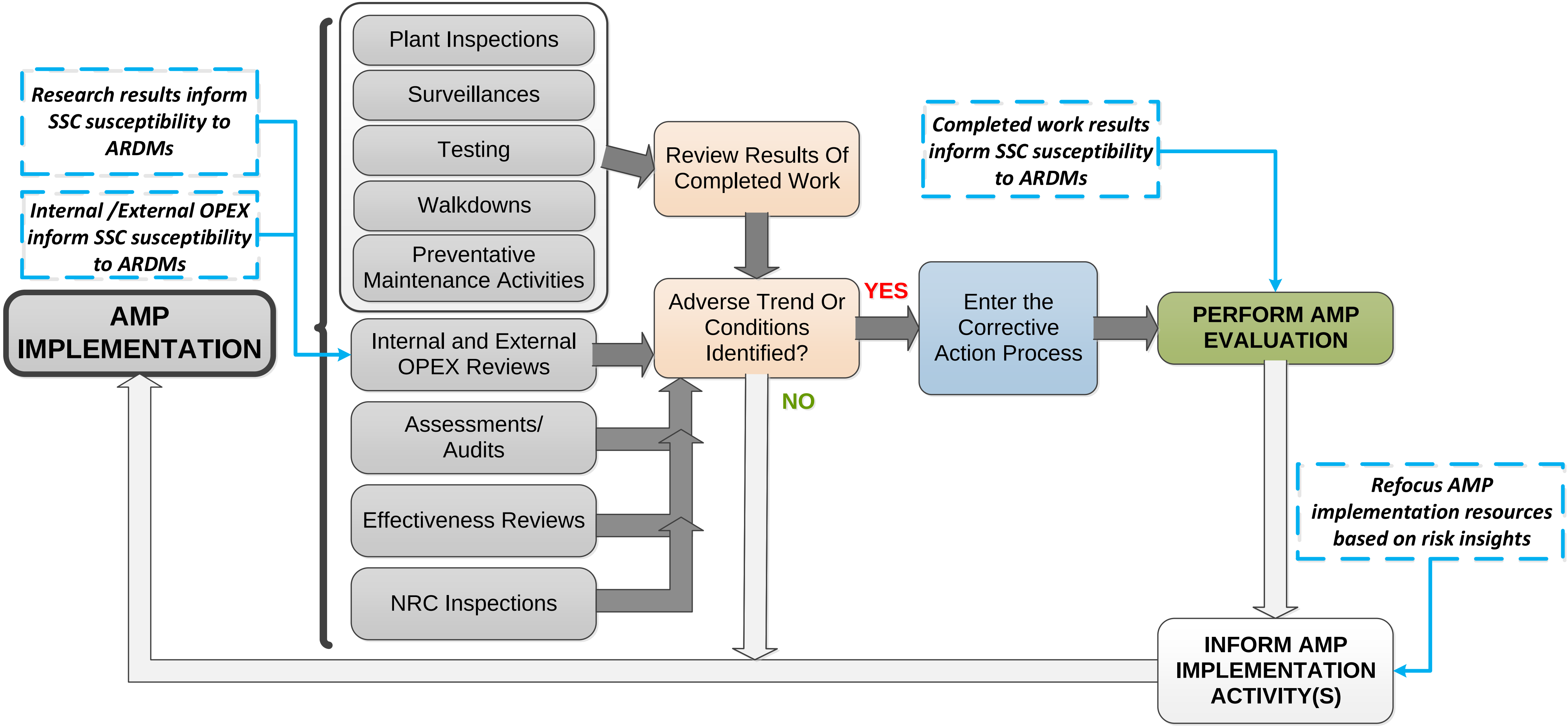
Note: the numbers are only for discussion purposes and have no other correlation

Evaluate Regulatory Implications (if any)



- Compare new / modified aging management strategies to existing License Renewal (LR) regulatory requirements
- Capture changes in Corrective Action Process
- Determine if the following regulatory requirements have been affected by the proposed changes:
  - Operating License Conditions
  - Updated Final Safety Analysis Report AMP descriptions and/or commitments table
  - Regulatory Commitments
  - Docketed correspondence from LR application approval / Safety Evaluation Report issuance process
- Implement the appropriate LR requirement/regulatory change processes

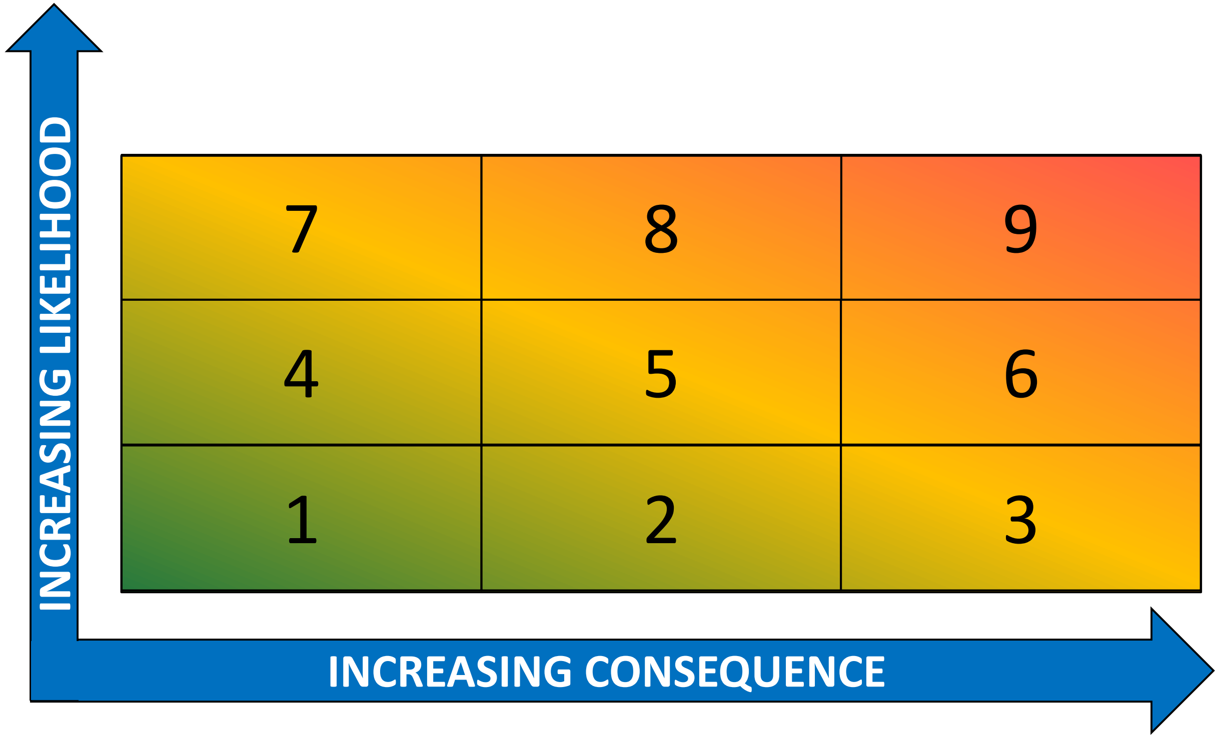
Potential Approaches to Leveraging Risk Insights



Note: Dotted blue boxes are the current potential approach

Summary of Framework Development Activities

- Review documentation collected
- Obtain additional information
- SSC identification and grouping
- Likelihood inputs and scaling
- Consequence inputs and scaling
- Populate risk matrix (initial)
- Review risk management strategies
- Revise risk rankings (as-left)
- Recommendations for AMP implementation
- Changes required to LR requirements
- Document key observations and changes to the framework
- Discuss and finalize cost/resource estimates and benefits



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Leveraging Risk Insights for Aging Management Program Implementation

Risk Insights Aspects

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Principal Technical Leaders, EPRI

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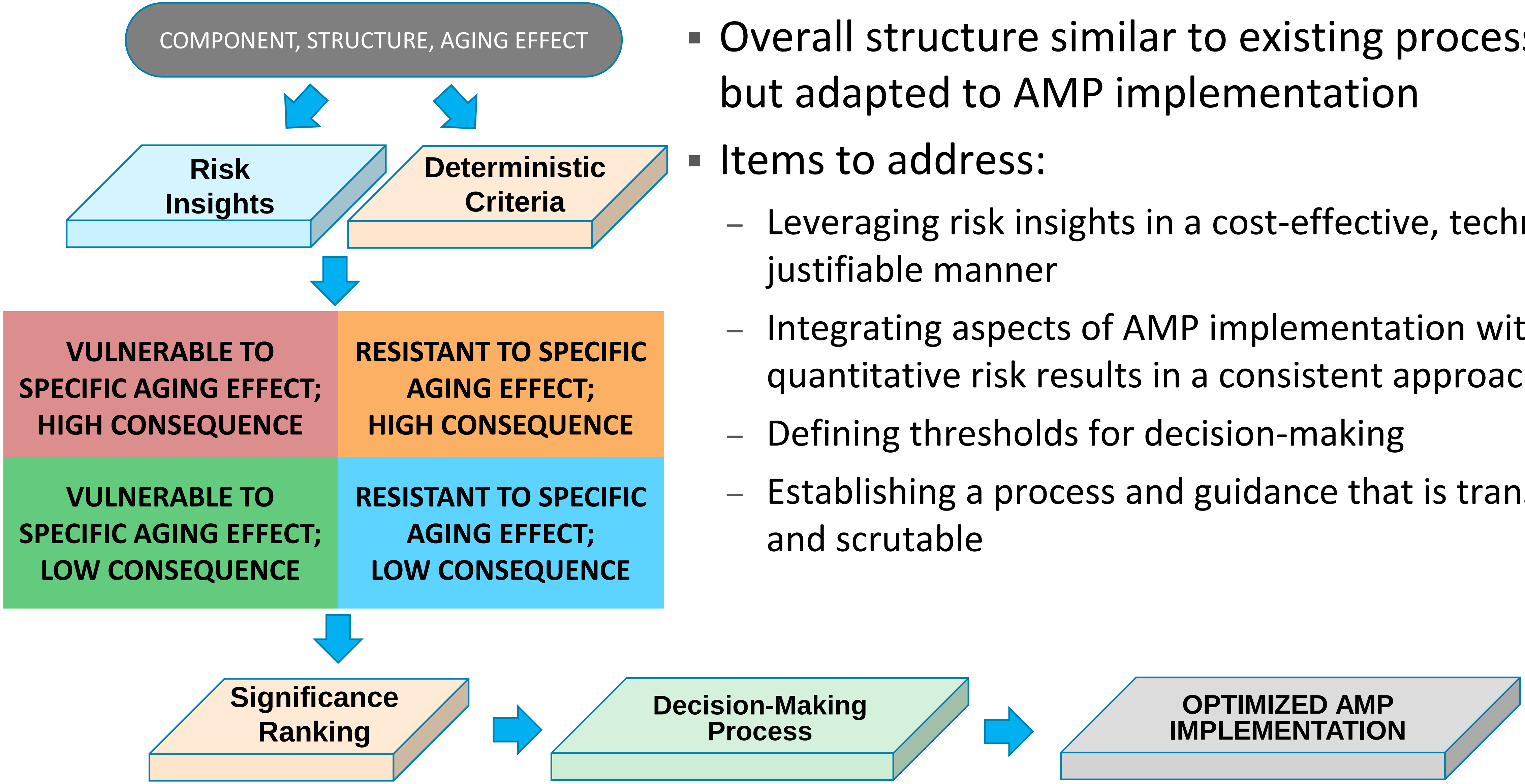
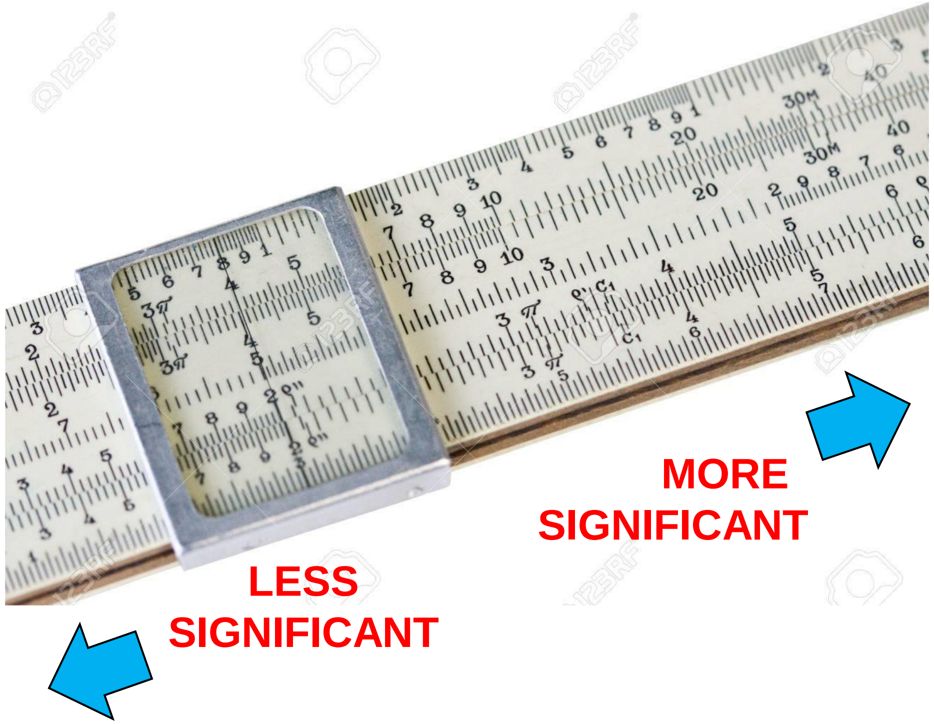
General Intent of the Framework - Use Existing Processes



- Overall structure similar to existing processes, but adapted to AMP implementation
- Items to address:
  - Leveraging risk insights in a cost-effective, technically justifiable manner
  - Integrating aspects of AMP implementation with quantitative risk results in a consistent approach
  - Defining thresholds for decision-making
  - Establishing a process and guidance that is transparent and scrutable

Background – Role of risk insights and PRA modeling

- Risk assessment may be used as a tool to better understand likelihood, impacts, and consequences
  - Role of risk insights for AMPs may be different than for other applications that have become risk-informed
  - Several risk-informed applications rely extensively on Probabilistic Risk Assessment (PRA)
  - Intent of this effort is not to develop an “Aging Management PRA” – we acknowledge limitations
  - Intent is to consider where PRA information can be incorporated in the decision making for AMP implementation
    - How important a specific System, Structure, or Component (SSC) is to overall safety/risk
    - How to consider likelihood of aging mechanisms
    - Impact on AMP implementation strategies



Use of Risk Insights in License Renewal Discussion

A review of key statements from the following documents was performed:

NRC Statements Of Consideration (SOC) for Nuclear Power Plant License Renewal (1991)

NRC SOC for Nuclear Power Plant License Renewal (1995)

Use of PRA Methods in Nuclear Regulatory Activities; Final Policy Statement (1995)

NEI 95-01 Rev. 6 Industry Guideline For Implementing the Requirements of 10 CFR Part 54 – License Renewal Rule

This effort is not intended to challenge Policy Statements or SOCs

Recognizes plant-specific PRA as an effective tool to provide integrated insights

Recognizes supplementing screening methods & aging management approaches using PRA

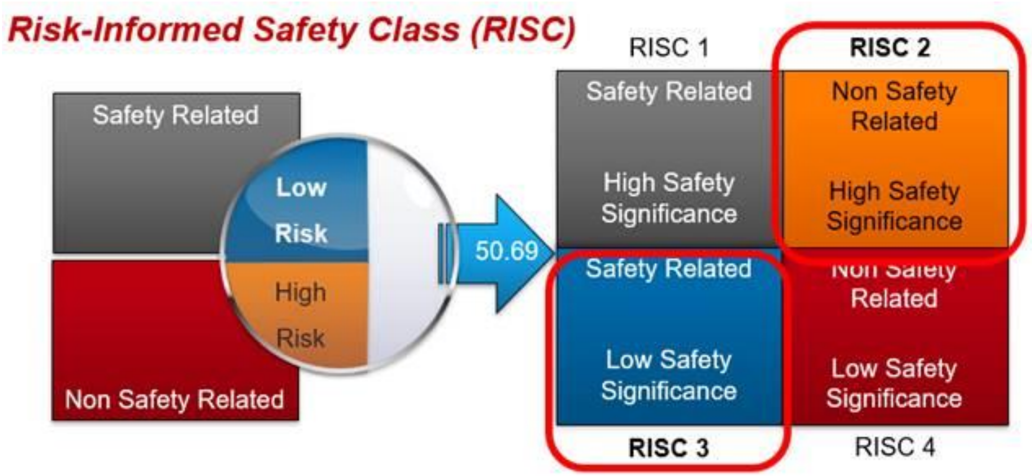
Recognizes a “layering” of risk insights over existing deterministic processes to better inform actions, define a proper safety focus (not intended to use PRA to justify AMP ineffectiveness)

Provides more specifics of where risk insights can be used while identifying challenges

Intends to use risk insights reduce unnecessary conservatism or support additional requirements (not intended to weaken requirements)

Use of Risk Insights in License Renewal Discussion

- Since 1995, the NRC and industry have significantly expanded use of PRA & risk insights:
  - Maintenance Rule
  - Risk-informed Oversight
  - Risk-Informed In-Service Inspection
  - **Risk-Informed Categorization of SSCs (§50.69)**
  - Risk-Informed Technical Specifications
  - Risk-Informed Fire Protection



- All operating reactors have invested heavily on site-specific PRA models that added significant quality and level of detail since the 1990s
- While the focus of each risk-informed application may be different, they have direct or indirect links to managing aging effects; to the extent that revisiting their use is critical
  - Direct impacts: e.g., risk-informed licensing basis (e.g., fire protection, §50.69)
  - Indirect impacts: e.g., available framework to assess new information, prioritize actions

Use of Risk Insights – Lessons Learned

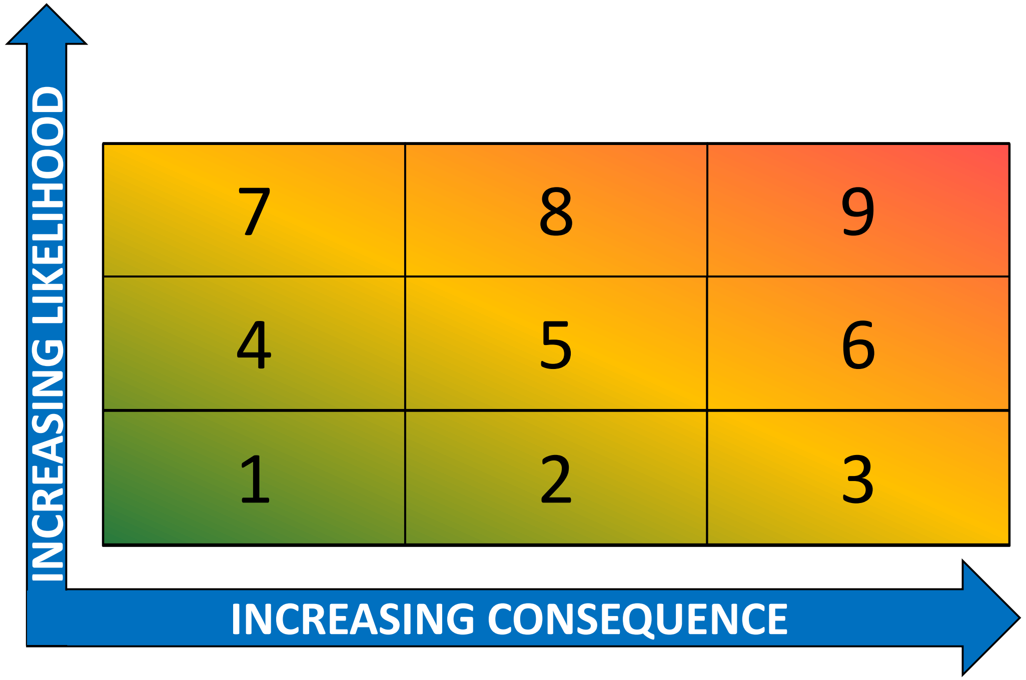
- Use of risk insights is general, in line with current implementation and defense-in-depth

Likelihood of Aging Effect on SSC → Impact of Aging Effect on SSC → Impact of SSC Failure on Plant Safety

e.g., is SSC more or less susceptible?

e.g., if aging effect is present, what is impact on SSC function?

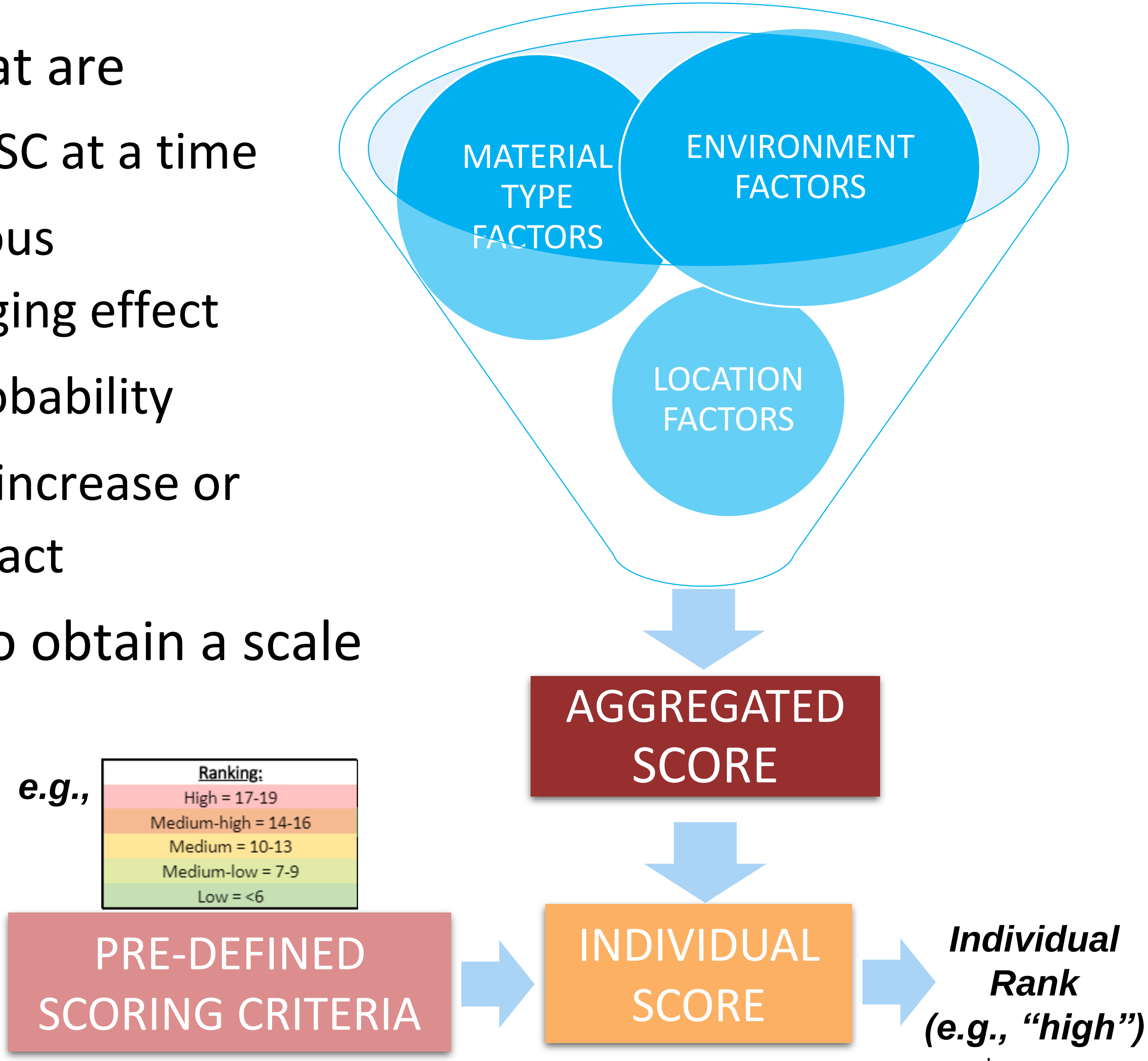
e.g., if SSC fails, what is the overall impact?



- Likelihood insights are expected to be more qualitative, semi-quantitative
  - Current direction is to use a scoring approach; identify contributing factors
- Consequence insights are expected to be a mix of quantitative AND qualitative
  - For example, §50.69 already used both quantitative and qualitative risk insights

Use of Risk Insights – Approach to Likelihood Input

- Define a set of major areas/factors that are
  - Factors are aging effect-specific, one SSC at a time
  - Intended to be robust, but not a rigorous estimate of likelihood/probability of aging effect
  - Engineering judgement used, <u>not</u> a probability
  - Each area has a number of factor that increase or decrease of aging effect presence/impact
- Scores were developed and iterated to obtain a scale
- Information is collected
- Each factor/attribute is scored
- Aggregate results are obtained
- General score criteria are defined



Ranking:
High = 17-19
Medium-high = 14-16
Medium = 10-13
Medium-low = 7-9
Low = <6

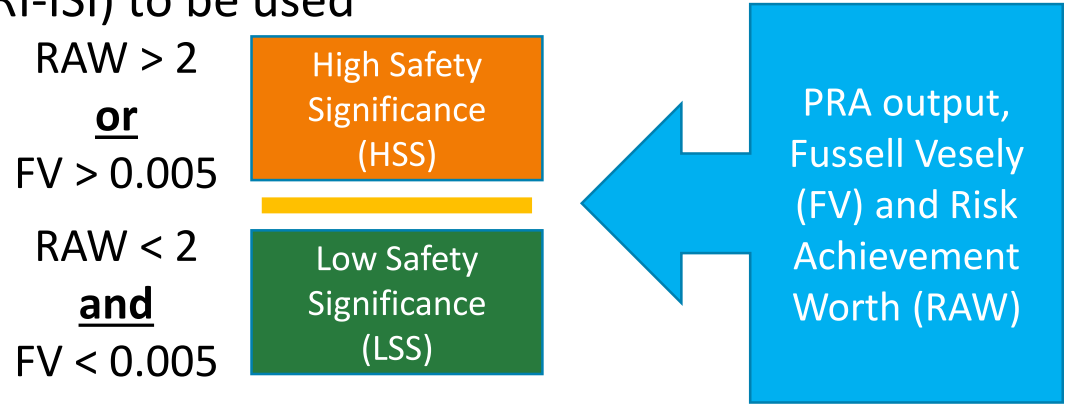
Use of Risk Insights – Approach to Consequence Input

- Large amount of risk information that can be leveraged already exists
  - Key issue is: can it be appropriately leveraged for AMPs?
  - Different aging effects may require different types of risk information
    - For example: selective leaching SSCs versus cable aging SSCs
- Several risk-informed processes can be leveraged for use with specific aging effects
  - For example, §50.69 already includes quantitative risk criteria
  - §50.69 includes a qualitative process for passive SSCs
  - §50.69 allows for Risk-Informed Inservice Inspection (RI-ISI) to be used

Source: NEI 00-04

DEFENSE-IN-DEPTH MATRIX

Frequency	Design Basis Event	≥3 diverse trains OR 2 redundant systems	1 train + 1 system with redundancy	2 diverse trains	1 redundant automatic system
>1 per 1-10 yr	Reactor Trip Loss of Condenser				
1 per 10-10^2 yr	Loss of Offsite Power Total Loss of Main FW Stuck Open SRV (BWR) MSLB (outside cntmt) Loss of 1 SR AC Bus Loss of Instr/Cntrl Air			POTENTIALLY SAFETY SIGNIFICANT	
1 per 10^2-10^3yr	SGTR Stuck Open PORV/SV RCP Seal LOCA MFLB MSLB Inside Loss of 1 SR DC bus	LOW SAFETY SIGNIFICANCE CONFIRMED			
<1 per 10^3 yr	LOCAs Other Design Basis Accidents				



Source: NEI 00-04

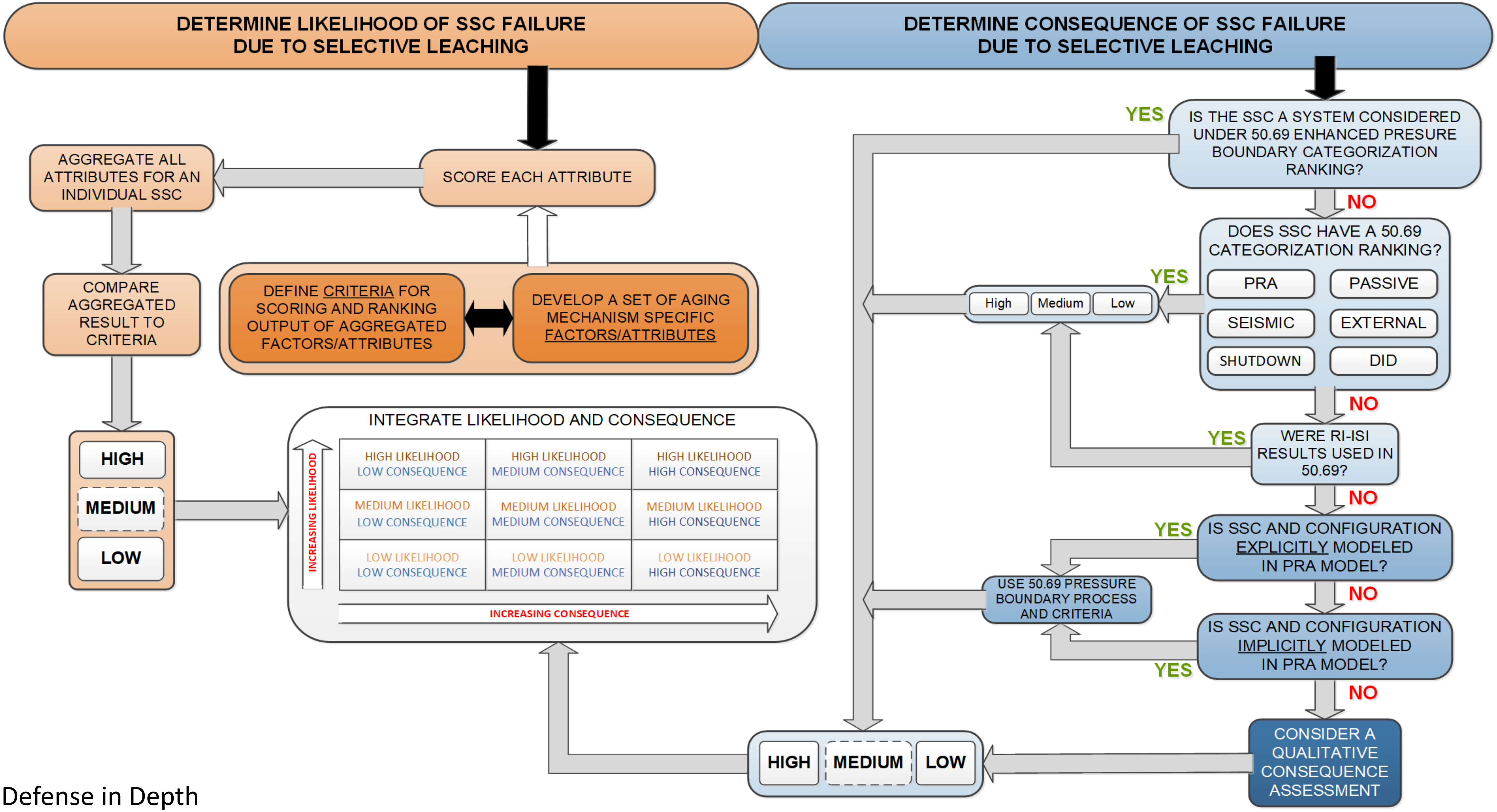
Consequence Evaluation

Failure Potential Assessment ***(Degradation Mechanism)***

DEGRADATION CATEGORY Pipe Rupture Potential	CONSEQUENCE CATEGORY CCDP and CLERP Potential: NONE	LOW	MEDIUM	HIGH
HIGH	LOW (Cat. 7)	MEDIUM (Cat. 5)	HIGH (Cat. 3)	HIGH (Cat. 1)
MEDIUM	LOW (Cat. 7)	LOW (Cat. 6)	MEDIUM (Cat. 5)	HIGH (Cat. 2)
LOW	LOW (Cat. 7)	LOW (Cat. 7)	LOW (Cat. 6)	MEDIUM (Cat. 4)

Source: RI-ISI

Use of Risk Insights – Potential Detailed Process (To be Piloted)



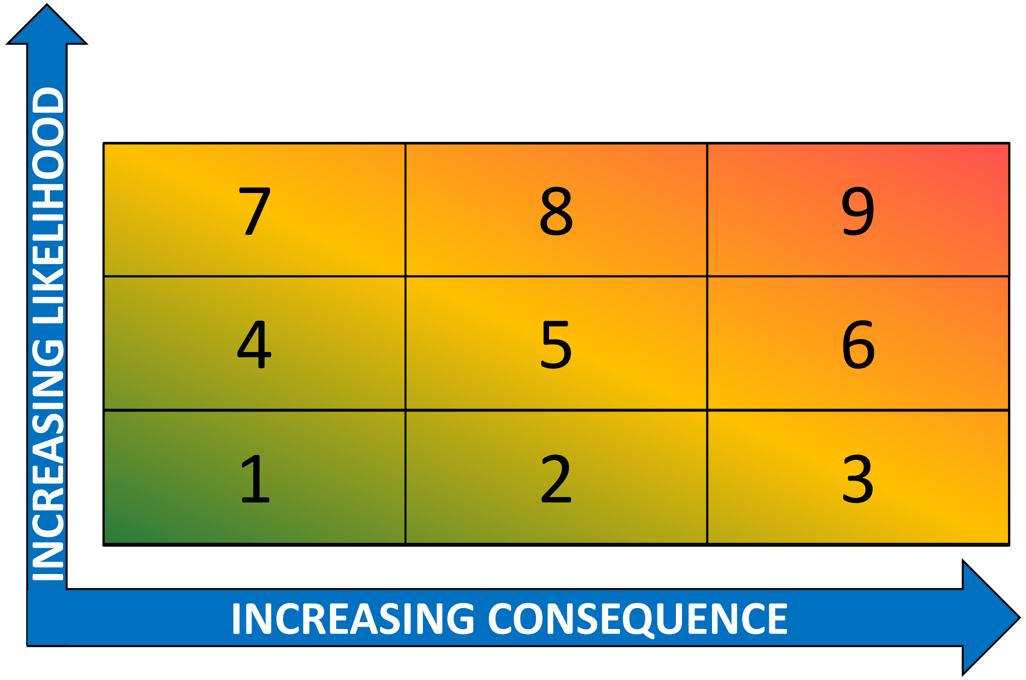
DID – Defense in Depth

Use of Risk Insights – Framework Outcome (In development)

if §54.4(a)(2) + higher risk

Evaluate existing controls

Consider if additional controls needed



if §54.4(a)(1) + higher risk

Continue to implement existing controls

if §54.4(a)(1) + lower risk

Identify Alternate approaches to support intended function

Implement alternate approaches as needed

Use of Risk Insights – Lessons Learned

- Developing a scoring approach that informs likelihood tested for two AMPs
- Using large amounts of risk information can be challenging (a lot of options!)
  - Does the **HSS/LSS §50.69** categorization make sense vis-à-vis **§54.4(a)(1-3)**?
  - Should the same importance measures be used as in **§50.69**? Other measures?
  - Should RI-ISI be used directly for specific passive SSCs?
- Key information to obtain if PRA model is to be leveraged:
  - Is the specific function of SSC under 10 CFR Part 54 modeled in PRA?
  - If not modeled, can it be indirectly modeled under a surrogate impact?
  - If not modeled (very low risk), is there documentation that can be leveraged?
- Pilot activities will use wider information and integrate likelihood/consequence
- Overall, aggregated results for various SSCs will be obtained, studied

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Leveraging Risk Insights for Aging Management Program Implementation

Selective Leaching Tabletop

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Principal Technical Leaders, EPRI

Barry Thurston
Sr. Staff Engineer / Corporate Aging Management Coordinator, Exelon

NRC Public Meeting - Virtual
October 1, 2020

Overview: Optimize Sample Population for Selective Leaching AMP Inspections

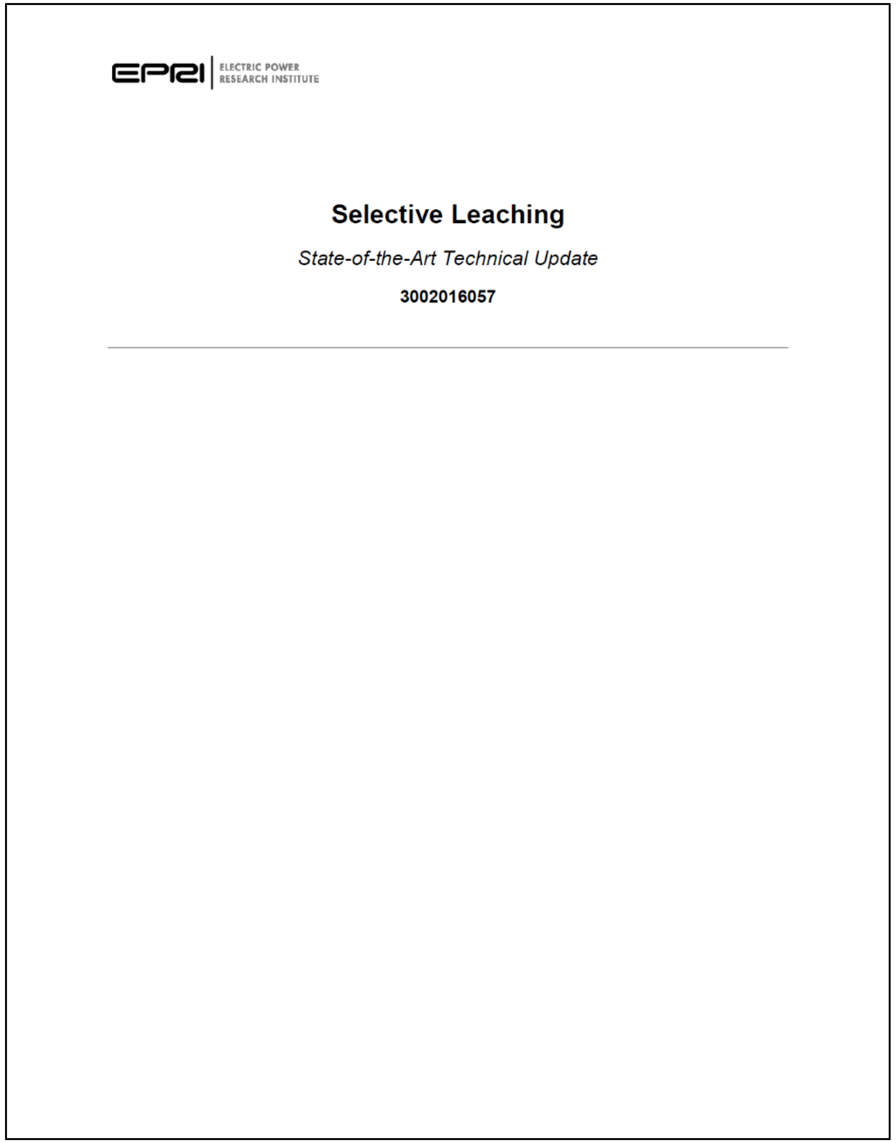
- Limited Selective Leaching found in certain components during pre-period of extended operation (PEO) inspections
- AMP requires expansion of scope of pre-PEO inspections and possibly creation of an ongoing AMP during PEO
- Goal: use risk insights to guide selection of components for extent of condition inspections and scope of on-going AMP (if required)

Team Members

- Exelon
  - Exelon Corporate Aging Management Coordinator
  - Exelon Corporate Risk Management personnel
- Industry License Renewal and Risk Management peers
- EPRI
  - Selective Leaching Expert
  - Risk Expert
  - EPRI 10 CFR 50.69 and Enhanced Pressure Boundary Categorization Expert
  - Aging Management Expert
- Vendor Support (Enercon)

Information Collected

- Initial Collection
  - Station Selective Leaching Inspection Sample Basis Document
  - Station System Aging Management Review Reports
  - Station System and Structure Scoping Reports
  - Station 10 CFR 54.4(a)(2) Scoping and Screening Basis Document
  - Station Selective Leaching Inspection and Destructive Examination Analysis Reports
  - Station 10 CFR 50.69 System Categorization Reports
  - Station Risk-Informed ISI Procedures
  - Corporate and Plant Nuclear and Enterprise Risk Management Procedures
  - Corporate Corrective Action Process Procedures
  - EPRI's Selective Leaching: State of the Art Technical Update
- Supplemental Information Collected
  - System Engineer input on normal system operating parameters
  - Station Cathodic Protection Survey Report
  - Station PRA results and products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Selective Leaching

State-of-the-Art Technical Update

3002016057

Identification and Grouping of SSCs

- Scope includes two material types located in buried or various water environments susceptible to selective leaching- gray cast iron and copper alloy >15% Zinc.
  - 293+ components with 20 different component types across 11 systems
  - **Majority of components scoped into LR under the 10 CFR 54.4(a)(2) criterion and have a LR intended function of leakage boundary to protect nearby safety related SSCs from failure due to spatial interactions**
  - None of these components are from systems classified as “high energy”- failure effects such as pipe whip, jet impingement, etc., were not considered further
- Scope and grouping of SSCs in this AMP most explicitly defined in the Selective Leaching Inspection Sample Basis Document
  - Some component types such as piping, valves and hydrants were not broken down any further
  - **Additional effort to refine these groupings deferred to the pilot**
- SSCs loaded into a spreadsheet that includes system name, SSC type, Unit, SSC Equipment Identification No., Safety Class, Location, Target SSCs, material of construction, environment, and intended function

Defining and Scaling Likelihood of Failure Inputs

- Developed through a review of EPRI Selective Leaching State of the Art Technical Report and discussion with team
- Created a screening table similar to the Buried Pipe risk ranking strategies
- Both qualitative and quantitative environmental parameters included
- **Few examples of site-specific operating experience (OE) of Selective Leaching**
  - Validated through destructive analysis
  - Examples were all gray cast iron buried fire protection piping and components
- **Material type (copper alloy vs. cast iron, etc.) not included due to lack of material susceptibility information. It is considered in combination with environment.**
- Buried components may have separate entries for internal and external environment susceptibility
- Each factor assigned a weighting (e.g., 1-3, 1-4, etc.) and sum of the factor scores establish the components' overall score
- Overall score determines components' likelihood of failure- likely, possible or highly unlikely

Preliminary Selective Leaching Likelihood Table

Selective Leaching Likelihood Screening Table		
Component ID:		
Operating Experience		
Previous SL Inspection Results based on M/E	Weighted Score	Result
Loss of intended function has occurred due to SL	5	
Advanced degradation has occurred due to SL	3	
No available OE	2	
Little or no presence of SL observed	1	
Environment[1]		
Environment	Weighted Score	Result
Buried/Soil	4	
Condensation	3	
Closed Cycle Cooling Water	3	
Raw Water	2	
Treated Water	1	
Condensation/water [int]-specific factors		
Temperature	Weighted Score	Result
>100 ^{o}F	3	
70-100 °F	2	
<70 ^{o}F	1	
Flow Rate	Weighted Score	Result
Stagnant during normal operation	4	
Intermittent flow rate during normal operation	3	
Consistent flow rate during normal operation	1	

Buried/Soil [ext]-specific factors		
Soil Corrosivity	Weighted Score	Result
High	3	
Medium	2	
Low	1	
Cathodic Protection	Weighted Score	Result
Not installed or not operating	3	
Operating but not monitored or maintained	2	
Periodically monitored and maintained	1	
Coatings	Weighted Score	Result
No coating present	3	
Coating present but not monitored or maintained	2	
Coating periodically monitored and maintained	1	

Input to Risk Matrix

Buried/Soil [ext]			Condensation/water [int]	
Min score:	8		Min score:	4
Max score:	18		Max score:	18
Score Range	SL Likelihood		Score Range	SL Likelihood
≥15	Likely		≥12	Likely
11 to 14	Possible		7 to 11	Possible
≤10	Highly Unlikely		≤6	Highly Unlikely

Defining and Scaling Likelihood of Failure Inputs (cont.)

- Individual susceptibility factor weighting <u>and</u> overall scoring thresholds provide the opportunity to bias the rankings as necessary
- **Component scoring heavily biased towards site-specific OE. Distinctions made between Selective Leaching being observed and inspected**
- Factor weighting and overall ranking thresholds still being finalized. It is expected that they may change based on industry OE and research

Once Finalized, this Table Could be Applied Across the Industry

Defining and Scaling Consequence of Failure Inputs

- Ongoing development through review of the following documents and discussion with team members:
  - 10 CFR 50.69 Categorizations for systems of interest
  - Risk Informed-Inservice Inspection results
  - PRA Basic Event data
  - Internal events, internal fire, and internal flooding PRA data
- **Considering how to accurately correlate standard risk analysis outputs to the consequence of loss of intended function of the in-scope structures and components**
- **Determination of a final consequence value for a structure or component may be an iterative process**

Special Considerations for 10 CFR 54.4(a)(2) Components

- Consequence of failure
  - Non-safety related in-scope component is not the focus
  - Safety related target component <u>is</u> important and the focus
- **Internal flooding PRA or results of the Enhanced Pressure Boundary Categorization Process**
  - **May be a direct way of assessing the consequence of failure of the non safety related component <u>AND</u> its safety related target**
  - **These analyses account for spatial interaction effects of failure on surrounding safety related SSCs**
- Detailed walkdown results from internal flooding PRA development may be useful to reduce excess conservatism during initial LR scoping

Next Steps

- Evaluate likelihood of all in-scope SSCs using Likelihood inputs and scaling developed in the Tabletop
- Complete the development of consequence inputs and scaling based on information available in Station PRAs, 10 CFR 50.69 Risk Categorizations and other risk analyses (as applicable)
- Evaluate consequence of failure of all in-scope SSCs
- Populate the risk matrix
- Review current aging management strategies and develop recommendations for alternative replacement or inspection strategies based on the risk rankings
- Determine the License Renewal requirement changes necessary to implement these recommendations

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Leveraging Risk Insights for Aging Management Program Implementation

Cables Tabletop

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Principal Project Manager and Principal Technical Leader, EPRI

Jessica Bock
Cable & Transformer Programs Engineer, Ameren

NRC Public Meeting - Virtual
October 1, 2020

Overview: Determine Possible Technical Basis for XI.E3 AMP ISG to Allow 10 Year Test Frequency

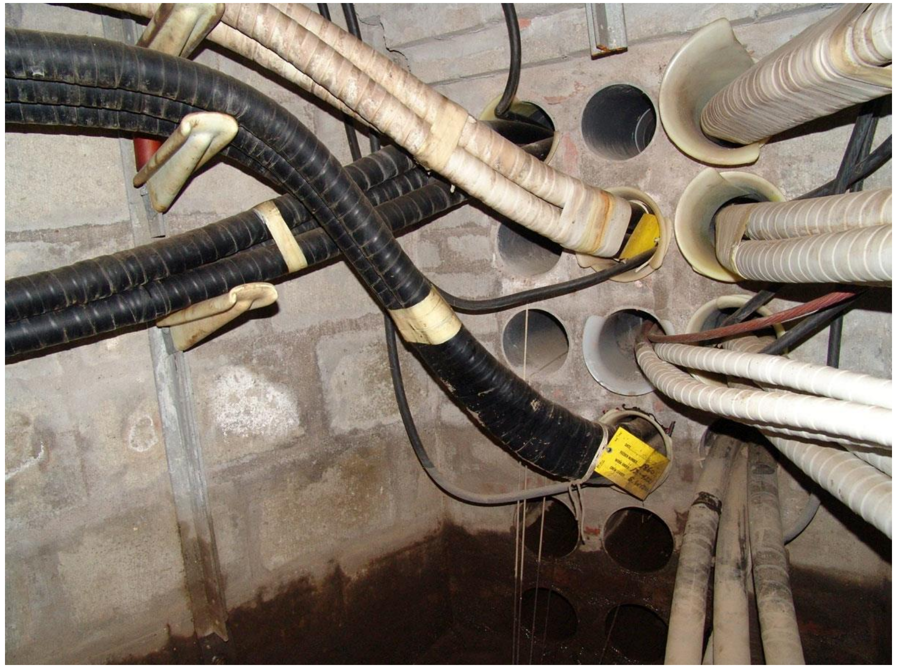
- Effort is underway to perform risk insight review using EPRI report 3002018403
  - High level tabletop to evaluate the draft guidance (May-present)
    - AMP degradation modes identified, scope identified, likelihoods of failure and rankings completed
    - Consequence of failure and rankings in-progress
  - Pilot to finish by end of 2020
- Is an Interim Staff Guidance (ISG) warranted to extend cable testing beyond required 6 years?
  - NEI and the License Renewal Electrical Working Group decision/action
  - Extending frequency will allow more efficient use of resources if risk of failure is not impacted

Team Members

- Callaway
  - Cable Program Owner
  - PRA Experts
- Industry License Renewal and Risk Management peers
- EPRI
  - Cable Expert
  - Risk Expert
  - Aging Management Expert
- Vendor Support (Enercon)

Initial Information Collected

- Callaway medium voltage cables within the scope of XI.E3
- Cable specifics (age, manufacturer, insulation type, operating voltage, etc.)
- End component(s) that a cable failure would effect
- Cable routing information (i.e. underground, direct buried, embedded conduit, etc.)
- License renewal function
- Previous test results
- Operating experience
- Risk information
  - RAW and Birnbaum (internal events, fire, high winds, seismic)
  - Core damage frequency results and Large Early Release Frequency (LERF)

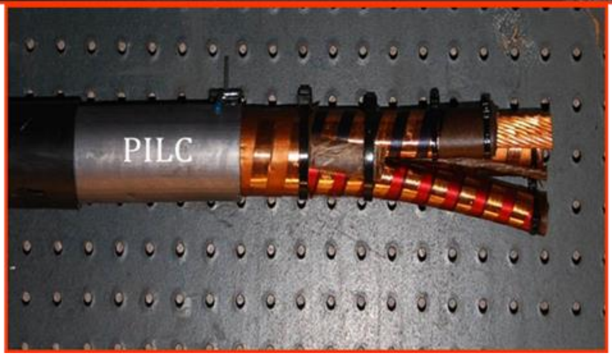


Identification and Grouping of SSCs

- Scope of Callaway XI.E3 AMP
  - 111 cable circuits
  - Two cable insulation types (brown and pink ethylene propylene rubber)
  - Metallic shield type (none, Zinc, Copper)
  - Operating voltages from 4 kV to 13.8 kV
  - Inspection results for wetting (always dry, previously wet, periodically wet, unknown (embedded conduit))
  - Splices (yes, no, how many)
- SSCs loaded into a spreadsheet as defined in previous slide

Defining and Scaling Likelihood of Failure Inputs

- Developed through team members knowledge of industry, DOE, and NRC research, industry OE and Callaway site-specific OE on the factors that influence the aging effects identified in XI.E3
- Created a screening table that includes the factors that influence aging effects for wetted cables that includes
  - Insulation types used across the nuclear industry (EPRs (black, pink, brown, XLPE, TR-XLPE and PILC)
  - Environmental factors (always dry, history of being wetted, etc.)
  - Shield type
  - Number of splices
  - Historical test data
- Each factor was assigned a weighting between 0-5 (higher weight) or 0-3 (lower weight)
- Overall score determines components' likelihood of failure- likely, possible or highly unlikely



EPR - Ethylene Propylene Rubber

PILC - Paper Insulated Lead Covered

TR-XLPE - Tree retardant XLPE

XLPE - Cross-linked Polyethylene

Likelihood of Failure

Likelihood Index

Increasing Likelihood

Cable Parameter	0	1	2	3	4	5
Insulation		Other (ex. pink/brown EPR)	---	---	---	Black, XLPE, Butyl Rubber, Compact (black or pink)
Inaccessibility		Always dry	History of previous wetting, but now kept dry	Occasional wetting	---	Can't keep dry
Shield type	Non-shielded	Copper, drain wire type, concentric neutral, LCCS	Zinc not previously wetted	Zinc previously wetted		
Splices		No splices	One splice	More than one splice		
Test data	Multiple good tests	One good test	No data – assumed dry	No data – assumed wet*	Further study required	Action required

* assumed previous long-term submergence cases are considered a 3 until tested otherwise

Ranges:
High = 17-19
Medium-high = 14-16
Medium = 10-13
Medium-low = 7-9
Low = ≤6

Next Steps

- Develop of consequence inputs and scaling based on information available in Callaway's PRAs (e.g., Fire), 10 CFR 50.69 Risk Categorizations and other risk analyses (as applicable)
- Evaluate consequence of failure of all in-scope SSCs
- Populate the heat map for Risk and Likelihood
- Review current aging management strategies and develop recommendations for alternative replacement or inspection strategies based on the risk rankings
- Determine the License Renewal requirement changes necessary to implement these recommendations

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Leveraging Risk Insights for Aging Management Program Implementation

Lessons Learned and Path Forward

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Principal Technical Leader, EPRI

NRC Public Meeting - Virtual
October 1, 2020

Overall Lessons Learned in the Tabletops

- Obtaining good detailed SSC data is key
- Technical experts can determine initial likelihood factors and scaling independently
- Likelihood factors can largely be universally applied, but the specifics will be site specific
- Consequence factor concepts can be applied universally, but the specifics will be site specific
- Technical and risk experts are needed to determine initial consequence factors and scaling
- Utility peer participation is valuable
- Blending quantitative and qualitative risk information is a challenge
- Focus on nuclear safety consequences as a priority
- Non-PRA based risk factors (e.g., enterprise, financial, operational, regulatory) still need to be considered in management strategy

Leveraging Risk Insights Timeline

- 2019 (Fall) - 2020 (January) – Leveraging Risk Insights to Optimize Aging Management Program Implementation: 3002017865 (White Paper) – Released
- 2020 (Summer) – Tabletop Exercises based on Selective Leaching (XI.M33) and Cables (XI.E3)
- 2020 (Fall) – Tech Update: Long Term Operations: Leveraging Risk Insights for Aging Management Program Implementation: 3002018403 - Released
- **2020 (Fall-Winter) – Pilots based on the Summer Tabletop Exercises**
- 2021 – Report: Leveraging Risk Insights for Aging Management Program Implementation
- 2021 and beyond – as more EPRI research is completed, additional work will be completed to see the savings when compared to the pilots and presentations and reports will be generated

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