PSA TECHNIQUES IN COMPONENT RISK SIGNIFICANCE CATEGORIZATION FOR GRADED QUALITY ASSURANCE AND EXEMPTION FROM SPECIAL TREATMENT REQUIREMENTS (RISK INFORMED PART 50, OPTION 2)

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PRESENTED TO:

Use of PSA in Operation of NPPs and in Regulatory Decision-Making

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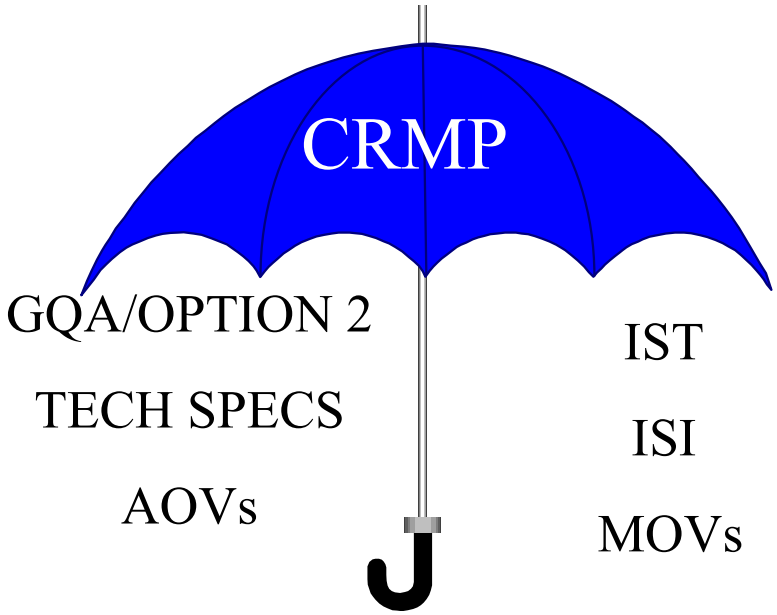
COMPREHENSIVE RISK MANAGEMENT

A process by which the change in risk to station personnel and the public's health and safety are evaluated as a result of changes in commitments, processes, activities, and human and equipment performance.



Graded Quality Assurance & Exemption from Special Treatment Requirements

KEY ISSUES TO BE COVERED IN THE LECTURE

- Understanding Component Importance
- Component Categorization - legitimizing the relative importance
- Treatment of Components - applications based on relative importance
- Application Examples: Equipment Qualification, Seismic, Maintenance Rule, Appendix J testing
- Exemption from 10CFR Part 50 Special Treatment Requirements
- Industry Activities and Challenges

REFERENCE MATERIALS FOR FURTHER REVIEW

1. South Texas Project letter to the Nuclear Regulatory Commission dated July 13, 1999 'Request for Exemption to Exclude Certain Components From The Scope Of Special Treatment Requirements Required by Regulations'

2. SECY-98-0300, Options for Risk-Informed Revisions to 10 CFR Part 50

3. SECY-00-0194, Risk-Informing Special Treatment Requirements

4. Nuclear Regulatory Commission letter to the South Texas Project dated August 3, 2001 'Safety Evaluation on Exemption Requests from Special Treatment Requirements of 10 CFR Parts 21, 50, and 100 (TAC NOS. MA6057 and MA6058)

South Texas Project (STP) Overview

- South Texas Project is a two unit, four-loop Westinghouse PWR rated at 1250 MWe each
  - Initial power generated - Unit 1 in 1988, Unit 2 in 1989
  - Each unit is physically separate with few common systems

- South Texas Project is located about 85 miles southwest of Houston, Texas - located near the Gulf of Mexico

- South Texas Project Nuclear Operating Company is co-owned by four power companies

Introduction - Component Importance

- Existing deterministic regulations (10CFRs) broadly address a component's relative importance
  - Safety-related structures, systems, and components (SSCs) are viewed as 'important' while non-safety related SSCs are generally viewed as 'not important'
  - Existing regulations treat the applicable safety-related SSCs equally regardless of the role the SSC plays in mitigating core damage or protecting the health and safety of the public
  - The nuclear industry was challenged to 'blend' probabilistic and deterministic thinking to understand the true relative importance of all SSCs
  - These insights are paving the way for risk-informed approaches and regulations which will enhance nuclear safety while reducing licensee and regulator burden

Background

- A Graded Quality Assurance (GQA) Safety Evaluation Report (SER) was received by South Texas Project (STP) on 11/97
- Benefits were expected primarily in parts procurement
- GQA SER did not provide expected and required flexibility during implementation. Obstacles included:
  - ASME - Seismic
  - Class 1E - Environmental Qualification
- 'Request for Exemption to Exclude Certain Components from the Scope of Special Treatment Requirements Required by Regulation' submitted 07/99
- Approach represented the proto-typical Option 2 pilot per SECY 98-300 for risk-informing 10CFR Part 50

Background (cont.)

- SECY-98-0300 states:
  - ‘Under [Option 2], SSCs of low safety significance (from a risk-informed assessment) would move from ‘special treatment’ to normal industrial (sometimes called ‘commercial’) treatment, but would remain in the plant and be expected to perform their design function but without additional margin, assurance, or documentation’
- RAIs received 01/18/00 and responded to on 05/22/00
- Revised Exemption Request submitted 08/31/00
- Draft Safety Evaluation Report received 11/15/00
- FSAR 13.7 wording finalized 05/21/01
- Approved SER received on 08/03/01

SECY-98-0300 Option 2

- Per SECY 98-300, Option 2 would:
  - adjust the scope of SSCs to which special treatment requirements apply
  - adjust SSC scope without changing the regulations

  Low safety significant SSCs would:
  - remain in the plant
  - move from special treatment to normal commercial treatment
  - be expected to perform their design function but without additional margin, assurance, or documentation associated with high safety significant SSCs
- Adjustments to the regulation content (distinct from the scope) would be addressed under Option 3
- Safety-related SSCs would remain safety-related (not reclassified as non-safety related)

STP Foundational Principles in Piloting an Option 2 Approach

- Emphasis was placed on proper categorization of SSCs
- Current commercial practices are sufficient for LSS/NRS safety-related SSCs
- Details of commercial practices are unimportant to safety given the low safety significance of LSS/NRS SSCs
- No additional controls required over LSS/NRS commercial practices
- HSS/MSS SSCs would continue to be governed by existing regulations and non-safety related HSS/MSS SSCs would be evaluated for enhanced treatment
- Focus on procurement benefits to be gained from ASME, EQ, Seismic, and 1E exemptions

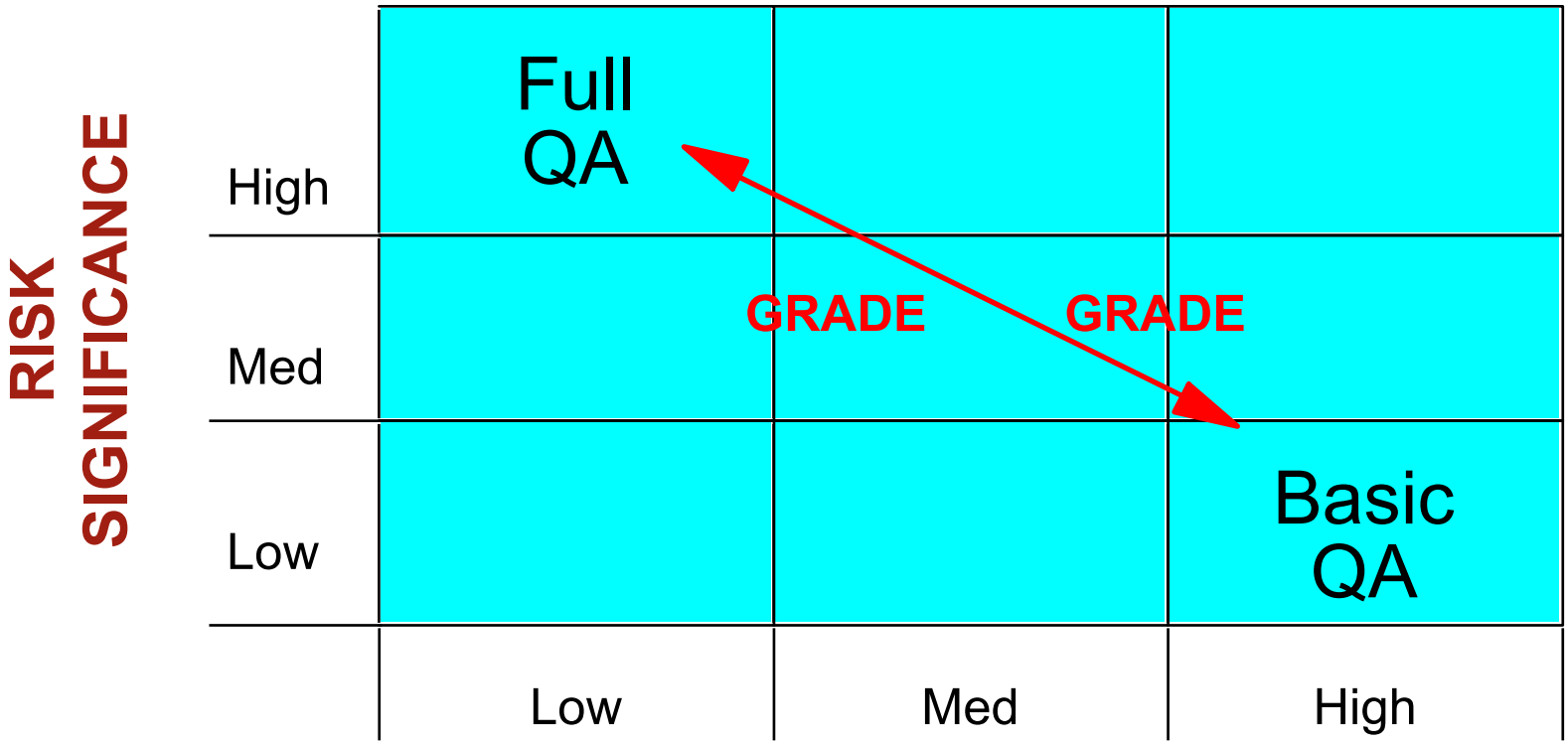
Categorization Approach at STP

- Categorization Process blended the following insights:
  - **PRA**
    - Review bases for model inputs and results
    - For modeled components, state the PRA risk
  - **Deterministic**
    - Identify all functions performed by system
    - Establish deterministic risk significance of each function
    - Identify functions supported by each component
    - Establish deterministic risk significance of each component

Categorization Approach at STP (cont.)

- Designate overall categorization, based on higher of PRA and deterministic risk
- Identify critical attributes for appropriate risk significant SSCs
- Results are presented to an Expert Panel for review and approval prior to implementation of results

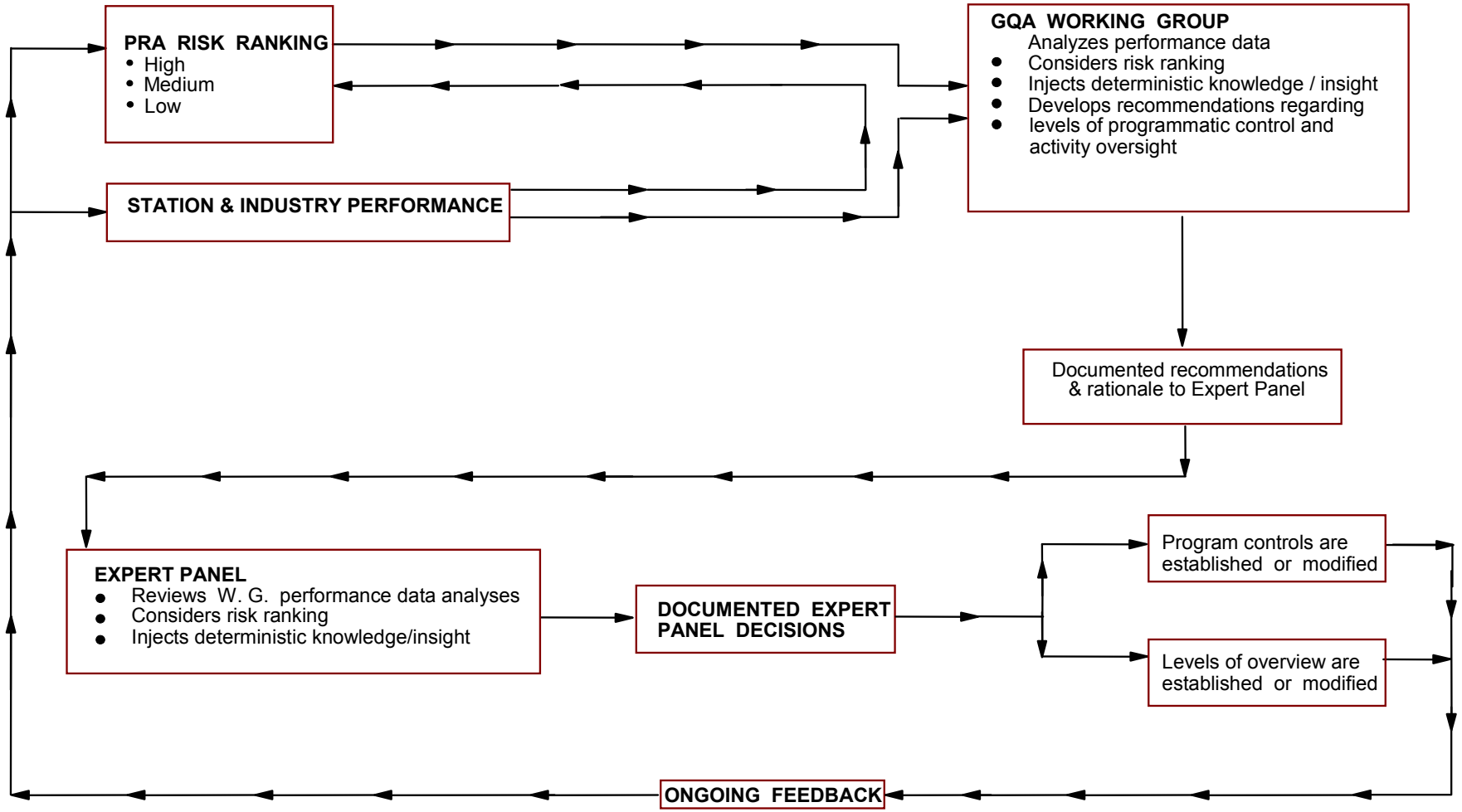
GRADED QUALITY ASSURANCE



Programmatic Activities

- MOV Program
- Seismic Evaluations
- Molded Case Circuit Breakers
- PM Optimization
- Procurement

Categorization Flowchart



ESSENTIAL ELEMENTS OF GQA

- ✓ Probabilistic Risk Assessment (PRA) Program
- ✓ Deterministic insight
- ✓ GQA Working Group
- ✓ CRM Expert Panel
- ✓ Continuous Performance Feedback
- ✓ Full QA Program
- ✓ Targeted QA Program
- ✓ Basic QA Program

EXPERT PANEL JUSTIFICATION

THE COMPREHENSIVE RISK MANAGEMENT EXPERT PANEL

- DIVERSE MULTIDISCIPLINARY MANAGEMENT TEAM THAT BLENDS DETERMINISTIC AND PROBABILISTIC INSIGHTS
- INCORPORATES FACTORS OUTSIDE SCOPE OF PSA/DETERMINISTIC ANALYSIS
- CONSIDERS THE USE OF EXPERT SOLICITATION (DELPHI METHODS)
- ASSESSES AGGREGATE AFFECTS OF ALL RISK INFORMED, PERFORMANCE BASED PROGRAMS

EXPERT PANEL MEMBERS AND RESPONSIBILITIES

MEMBERS

- Design Engineering Manager
- Nuclear Fuels & Analysis Manager (Safety Analysis)
- Nuclear Licensing & Quality Director
- Work Control Manager
- Risk Management
- Generation Support Manager

RESPONSIBILITIES

1. Approve the criteria for assessing the risk significance of SSCs.
2. Review and approve the risk significance assigned to SSCs.
3. Approve the criteria for assignment of QA grade levels for SSCs.
4. Review and approve the assignment of QA grade levels for SSCs.
5. Maintain cognizance over the implementation of the Graded Quality Assurance/Option 2/Comprehensive Risk Management Program and adjust program criteria as appropriate.
6. Approve and issue for plant use the Risk Significance Basis Documents.
7. Appoint Working Groups.

EXPERT PANEL FUNCTIONS

- **STRUCTURES** processes, **MAKES** decisions in accordance with its responsibilities under its charter, and **MAINTAINS** cognizance to ensure that its decisions are implemented

- **COMPENSATES** for the limitations of the PSA:
  - Uncertainties caused by model assumptions
  - Common cause or common mode failure rates
  - Treatment of support systems
  - Level of definition of cut sets, cut set truncation
  - Inclusion of repair and restoration of failed equipment
  - Human error rates
  - Limitations in the meaning of the importance measures.

- **DIRECTS** the activities of the Working Groups
  - Information gathering
  - Recommendation development

- **ADVOCATES / COMMUNICATES** the Comprehensive Risk Management Program

Functions to advance STP Personnel, NRC Staff and Public Understanding of and Support for the Comprehensive Risk Management Program.

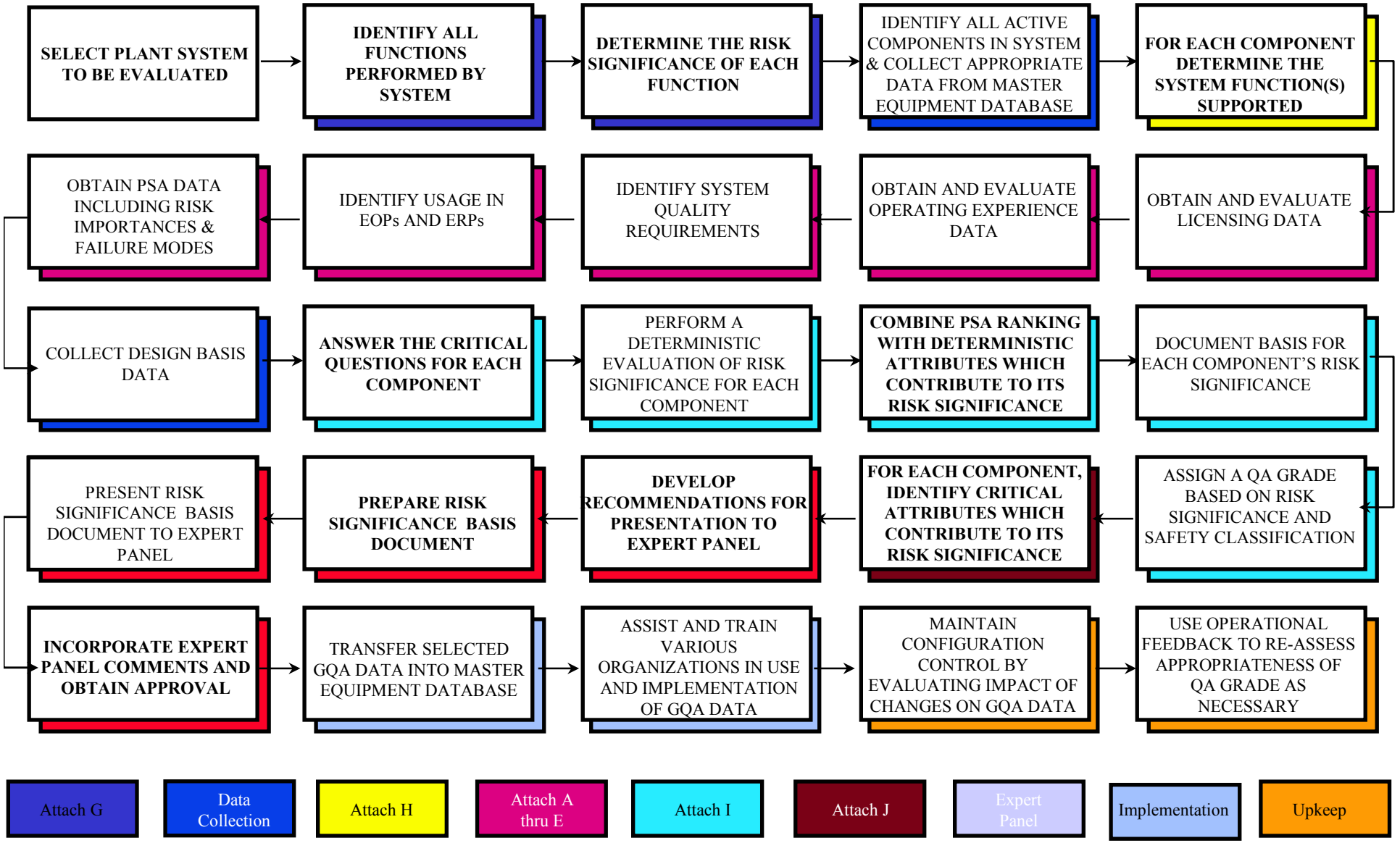
Categorization Controls

- Integrated Decision-Making process made up of a Working Group and Expert Panel
  - experienced, qualified personnel
  - diverse membership with consensus decision-making
- Process is procedurally controlled
- SSCs categorized into one of four categories:
  - HSS - high safety/risk significant
  - MSS - medium safety/risk significant
  - LSS - low safety/risk significant
  - NRS - not risk significant

PRA Categorization Approach

- PRA risk ranking is procedurally controlled
- Full scope model quantification includes an at-power Level 1 and 2 model with external events and internal floods/fires
- PRA models about 1200 SSCs for Unit 1
- PRA model is periodically updated to reflect changes in SSC performance and/or Station design/operation
- PRA categorization based on FV and RAW value criteria as shown:

GRADED QUALITY ASSURANCE WORKING PROCESS FLOW CHART



PRA Categorization

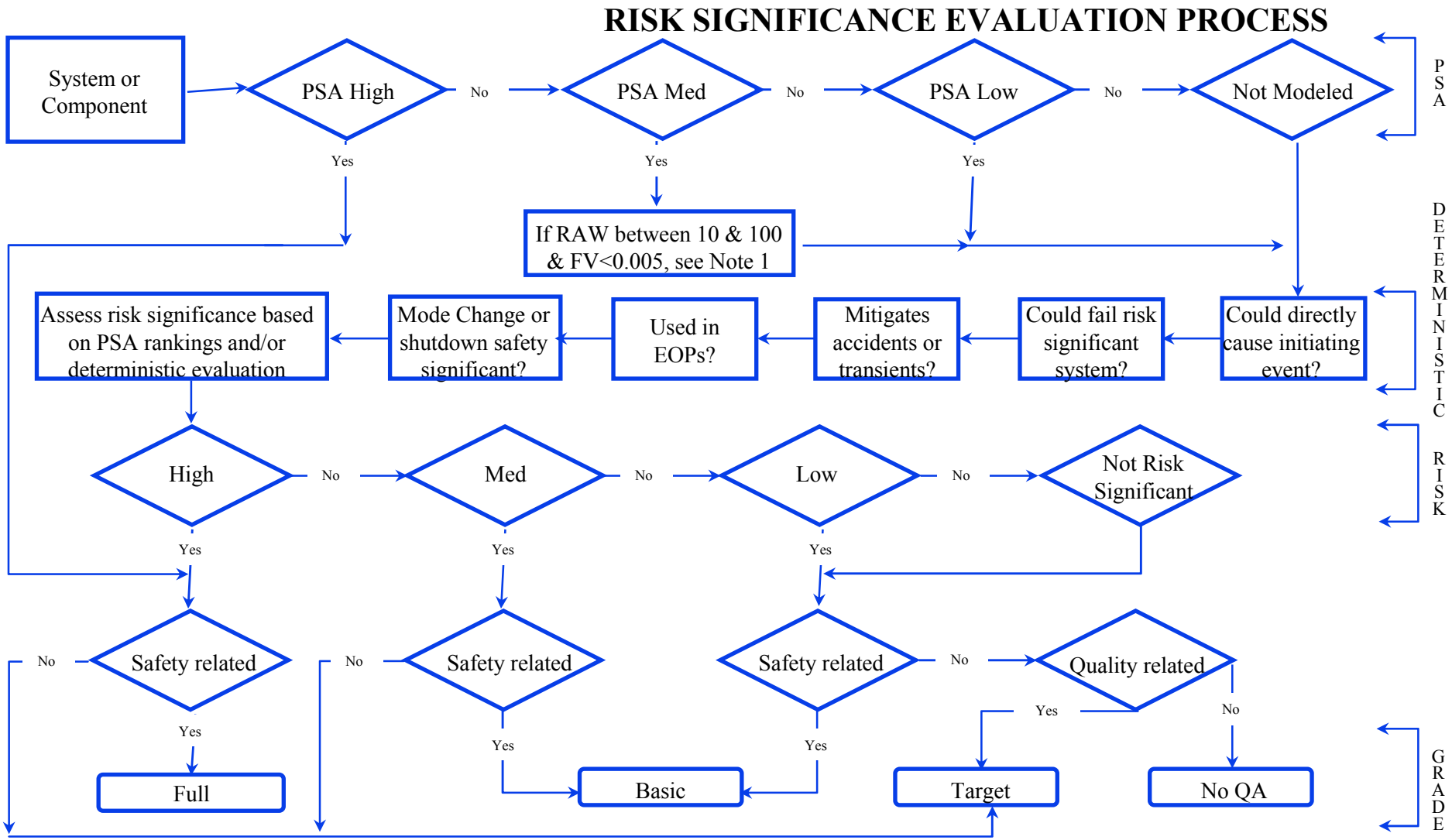
PRA Ranking	Criteria
High	**RAW ≥ 100.0 or** **FV ≥ 0.01 or** **FV ≥ 0.005 and RAW ≥ 2.0**
Medium –R*	**FV < 0.005 and 100.0 > RAW ≥ 10.0**
Medium	**FV ≥ 0.005 and RAW < 2.0 or** **FV < 0.005 and 10.0 > RAW ≥ 2.0**
Low	**FV < 0.005 and RAW < 2.0**

***Medium-Additional Review Required-Full QA program applied to those critical attributes associated with this PRA ranking.**

PRA Categorization Robustness

- Final PRA risk considers the results of 21 sensitivity studies:
  - Effects of Scheduled Maintenance
  - Removal of Operator Recovery
  - 10x Increased Failures for Low-Ranked Component
- Common Cause approach factored into PRA results
- PRA is procedurally updated on a periodic basis
- PRA is a comprehensive model that has been extensively reviewed by the NRC and others in the industry
- PRA recently completed the peer certification process

CATEGORIZATION OF PLANT SYSTEMS, COMPONENTS, AND ACTIVITIES



Note 1: SR Components with a Risk Achievement Worth (RAW) between 10 and 100 and a Fussell-Vesely (FV) value < 0.005 are to have Full QA applied to the critical attributes associated with that RAW and/or FV

Deterministic Function Categorization Approach

- Working Group consistently uses five critical questions at the system function level to guide the deterministic evaluation:

1. **Initiating Event** - Does loss of function, in and of itself, directly cause an initiating event?
2. **Fails Risk Significant System** - Does loss of function directly fail **another** risk significant system?
3. **Accident/Transient** - Is function used to mitigate accidents or transients?
4. **EOPs** - Is function specifically called out in EOPs and/or Emergency Response Procedures?
5. **Shutdown/Mode Change** - Is loss of function safety significant for shutdown or mode change activities?

Deterministic Function Categorization Approach

- Questions are individually weighted based on the importance to risk insights
- Positive responses to questions have a grading scale applied based on impact and frequency of occurrence
- Results are summed and categorized
- A high positive response to any one question is properly factored into the categorization to prevent masking

Deterministic Component Categorization Considerations

- Redundancy and diversity are factored into the final component categorization
- General Notes are used to optimize documentation for ancillary and passive components
- Final component categorization cannot be lower than the PRA rank, but can be deterministically ranked higher
- Failure to reach consensus on final categorization is forwarded to a more senior panel for resolution
- Categorization recommendations are forwarded to the Expert Panel for approval

DETERMINATION OF RISK

Answers:

“0”	**-**	**Negative Response**
“1”	**-**	**Positive response having insignificant impact and/or occurring very rarely**
“2”	**-**	**Positive response having minor impact and/or occurring infrequently**
“3”	**-**	**Positive response having low impact and/or occurring occasionally**
“4”	**-**	**Positive response having medium impact and/or occurring regularly**
“5”	**-**	**Positive response having high impact and/or occurring frequently**

DETERMINATION OF RISK

Weighting Factors:

Accidents/Transients, EOPs	5
Fails Risk Sig. System	4
Initiating Event, Shutdown/Mode Change	3

Score Range	Risk
0 - 20	NRS
21 - 40	Low
41 - 70	Medium
71 - 100	High

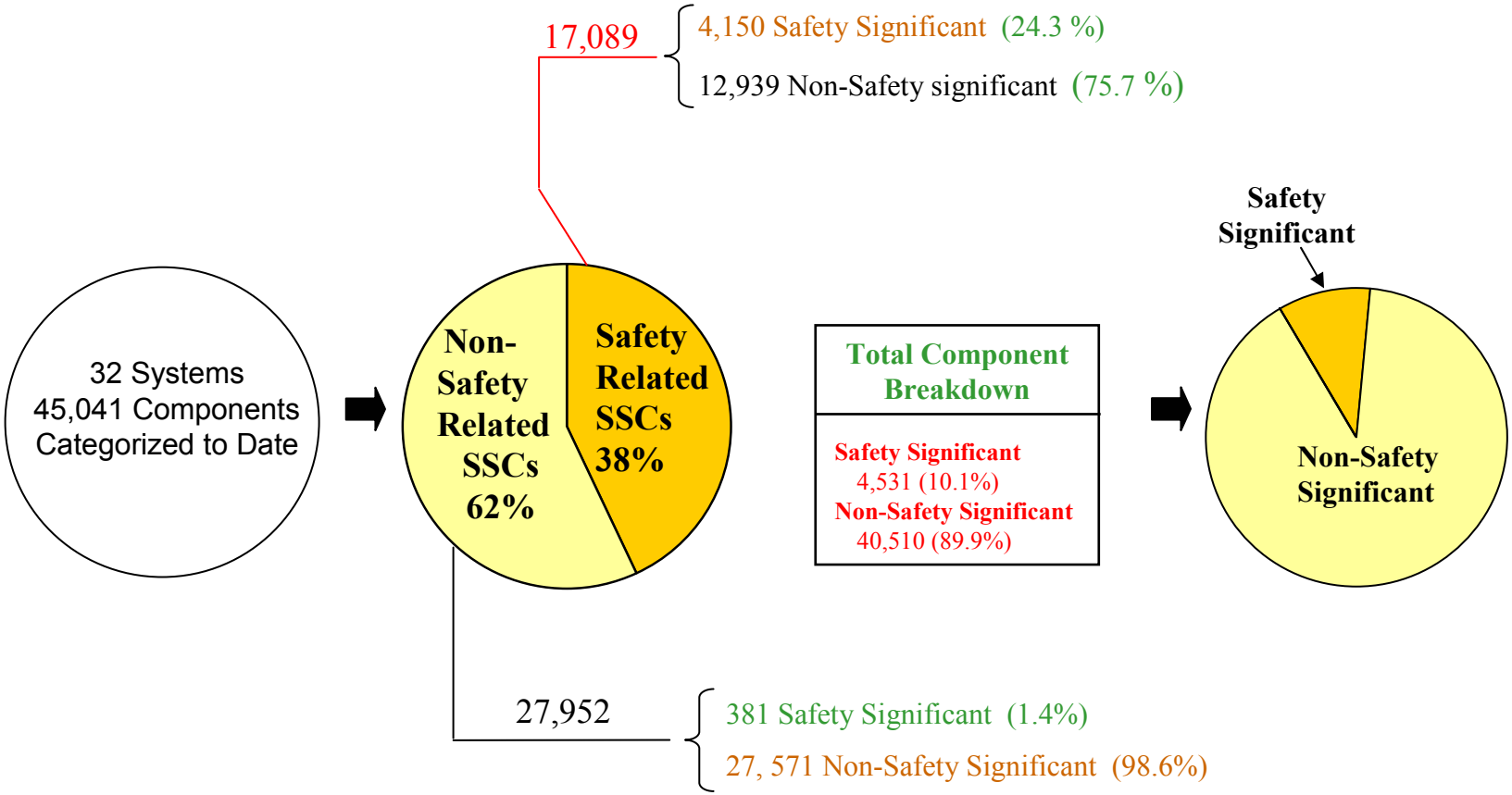
Categorization Results

- 41 systems (over 50,000 components) categorized to date
- SSCs categorized into four ‘buckets’:
  - HIGH - 3%
  - MEDIUM - 7%
  - LOW - 15%
  - NRS - 75%
- HIGH/MEDIUM SSCs are safety significant
- LOW/NRS SSCs are not-safety-significant

Results Broken Down

RISC - 1 **Safety-Related,** **Safety Significant** **4,197** **(8.8%)**	**RISC - 2** **Non-Safety Related,** **Safety Significant** **393** **(0.8%)**
RISC - 3 **Safety-Related,** **Not Safety Significant** **13,325** **(27.9%)**	**RISC - 4** **Non-Safety Related,** **Not Safety Significant** **29,906** **(62.5%)**

STP Categorization Results



Categorization Feedback

- Periodic feedback is provided to ensure categorization still proper. Consideration includes:
  - system engineer feedback
  - design changes
  - operating/industry experience
  - corrective action program (internal operating experience)
  - updated PRA model insights (revised failure rates, unavailabilities, procedures, etc)
- Categorization changes must be approved by Expert Panel before being implemented into Station processes

Categorization Summary

- Categorization process properly balances PRA input and deterministic insights resulting in a technically sound, well-documented product
- PRA and deterministic categorization processes produce comparable results
- Categorization process is a robust approach and supportive of risk-informed applications
- Feedback loop ensures that categorizations are periodically reviewed and updated - is performed at least once per refueling cycle

Treatment of Components - Why categorize components and treat them differently?

- Commercial practices have been demonstrated to be acceptable through improved industry-wide power plant capability and reliability factors
- Safety-related/non-safety related component failure rates are generally the same (NPRDS and EPIX data comparisons)
- It is expected that the least important components will continue to function when demanded - LSS/NRS components will continue to be maintained
- Even if one of these components were to fail, it would result in little to no impact on nuclear safety
- Nuclear safety is enhanced by focusing attention and resources on the most important SSCs

Special Treatment Requirements

- Special Treatment Requirements (STR) provide additional assurance that safety-related components will function beyond the assurance that commercial practices provide
- STR may provide benefit for the most important components, but not for the least important components
- The least important components (LSS/NRS) only need reasonable assurance that the design functional requirements will be met
- The least important components must still perform their functions when demanded

Treatment Adjustment Opportunities

- Treatment on the least important (LSS/NRS) safety-related components could be adjusted as follows:
  - failed components could be replaced with commercial replacement parts
  - ASME Class 2 and 3 components could be repaired or replaced following an ANSI commercial code
  - components will generally be outside of the Maintenance Rule scope
  - seismic and environmental qualified parts could be replaced with non-qualified replacement parts
  - containment penetration leakage tests could be eliminated

Treatment Adjustment Opportunities (cont.)

  - maintenance documentation could be reduced
  - testing of pumps and valves could be reduced
  - Class 1E parts could be replaced with commercial equivalents
  - Support/hanger inspections could be reduced
  - Part 21 reporting requirements eliminated
  - M&TE controls reduced
- Potential opportunities are broad-sweeping and require a deliberate, cautious approach
  - Process adjustments
  - Communications
  - Culture change

Scope of the STP Exemption

- 10CFR Part 21 (Vendor Notification)
- 10CFR50.49 (Equipment Qualification)
- 10CFR50.55 (ASME / ISI, IST)
- 10CFR50.59 (Change Control)
- 10CFR50.65 (Maintenance Rule)
- Appendix B (Quality Assurance Program)
- Appendix J (Containment Leak-tightness)
- 10CFR Part 100 (Seismic)
- STP committed to a deliberate/cautious implementation approach

STP Exemption

- Exemption granted 08/03/01 - STP did **not** look any different on 08/04
- Implementation activities being approached deliberately:
  - stakeholder communication and training held
  - business strategies and resources evaluated
  - detailed plans for implementation developed
- A new FSAR Section 13.7 was required to be added
  - insights provided on categorization and treatment processes
- FSAR 13.7 has its own change control process
  - based on ‘decrease in effectiveness’ resulting from the change

Application Experiences to Date

- **Local Leak-Rate Testing (LLRT)**
  - Scope of obligated containment isolation valve testing has been reduced by 55%
  - Two additional systems affecting LLRT remain to be categorized
  - Decision to exempt from testing should be based on functional categorization rather than on final component categorization only

- **Maintenance Rule (MR)**
  - Maintenance Rule Basis Document revised to factor in risk insights
  - Initial effort resulted in 3 systems being removed from MR scope

Application Experiences to Date (cont)

- Additional evaluations being done for additional scope adjustments
- Systems removed from MR scope are tracked by the Corrective Action Program

- **Appendix B**
  - Operations Quality Assurance Program (OQAP) revised to focus Quality oversight on safety significant activities only - streamlined efforts in receipt inspections, monitoring, assessments, etc
  - Tool-Pouch Maintenance procedure revised to permit skill-of-craft work activities using electronic documentation only on safety-related LSS and NRS components

Application Experiences to Date (cont)

- Preventive Maintenance (PM) scopes and frequencies modified on LSS/NRS components - resulted in over 5 man-years in labor savings and $60K parts savings per year

- **Parts Procurement**
  - Evaluate ability of commercial parts to satisfy safety-related design functional requirements
  - LSS valve flow guide - vendor quoted safety-related, qualified price of $34K for two guides - was able to procure two identical commercial flow guides for $842
  - LSS 1” vent and drain valves - safety-related price of $2400 each, commercial price of $500 - for intended lot of 100 valves to purchase, equates to a $190K one-time savings

Application Experiences to Date (cont)

- LSS flow switches used in 45 applications (18 SR, 27 NSR) - currently buy all switches as safety-related - SR switches cost $9K each, NSR cost $1200 each - SR switches are changed out every 5 years - by purchasing commercial and reevaluating the changeout frequencies, equates to a life-of-plant savings of $900K

- Relief Valves
  - STP adopted new edition of ASME OM code in December, 2001
  - New code required 180 relief valves to be added to Inservice Testing (IST) Program scope
  - Applying exemption, 162 of subject valves (90%) were LSS/NRS and were eliminated from the IST Program scope

Industry Option 2 Activities

- Nuclear Energy Institute (NEI) is coordinating industry activities to move forward with Option 2
  - NEI 00-04 ‘Option 2 Guideline’ is drafted and in review process
  - Industry approach closely follows the STP methodology
  - Four other plants have completed pilot categorizations to prove the proposed categorization approach
- New draft rule, 10CFR 50.69, is available on NRC website
  - Focuses on categorization and high-level treatment
  - Notice of Proposed Rulemaking (NOPR) due to Commission in September, 2002
  - Industry closely working with NRC staff on Rule language

Summary

- Categorization allows the true importance of components to be recognized - not all SR components are equally important - some NSR components are more important
- Opportunities exist to properly focus resources and attention on safety significant applications - results in overall beneficial safety impact
- Industry must continue to pursue risk-informed activities to improve the safety of plant operation, the effectiveness of plant maintenance, and the cost-benefit of long term reliance on nuclear power