Organizational Incorporation of Probabilistic Risk Assessment

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

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PRA GOOD PRACTICES OUTLINE

- Initial Considerations
- Elements of Comprehensive PRA Programs
- PRA Configuration Control
- Control of PRA Applications
- Concluding remarks

INITIAL CONSIDERATIONS

GENERAL CONSIDERATIONS

- Regulatory trends
- Evolving economic environment
- Status/maturity of utility PRA Programs
- Philosophy on the benefits/use of PRA
- Benefits of continuously improving knowledge levels of station personnel

PLANT SPECIFIC CONSIDERATIONS

- What does PRA bring to the table?
  - An integrated platform for decision making
  - An integrated plant performance assessment tool
  - A technical method to improve station economics and safety levels (i.e., optimize safety and costs)
  - Analytical tool for Strategic/Tactical management
- What are its appropriate uses?
  - Operational Decision Making
  - License Issue Resolution
  - Design Change Process
  - Risk Informed Asset Management
  - Plant/System Performance
  - Risk Ranking
  - Configuration Risk Management

PLANT SPECIFIC CONSIDERATIONS

- How is the PRA function incorporated into the station mission/organization?
  - Resources allocated commensurate with vision/mission
  - PRA Training
  - Risk informed performance indicators
  - Continuous flow of PRA products to customers
- How are operational applications of PRA incorporated into plant disciplines?
  - Approval processes, procedures, working groups, night orders
  - Points of contact for key stakeholder organizations
  - Desire to change and improve knowledge levels
  - Changing the culture

ELEMENTS OF COMPREHENSIVE PRA PROGRAMS

STRATEGIC ELEMENTS

- Strategic Vision and Policy
- Organization
- Functional Integration
- Comprehensive PRA methods/techniques
- Implementation
- Assessment of Aggregate Effects
- Continuous Improvement

STRATEGIC VISION & POLICY

- States the role of PRA in achieving the station's mission
- Establishes PRA as a part of the decision making process
- Identifies executive expectations
- Identifies key functional areas for application of PRA technology
- Identifies organizational responsibilities

STP PRA NUCLEAR GROUP POLICIES

- NGP-182, Use of Probabilistic Safety Analysis, addresses uses and limitations
  - "The Probabilistic Safety Analysis (PSA) is a valuable resource for STP."
  - "The continuing use of this analysis is encouraged."
- NGP-181, Shutdown Risk Assessment, addresses management guidelines, refueling outages, and forced outages
  - "Effective management of an outage is essential to provide safety to the station as well as the general public."
  - "To ensure proper management of refueling outages activities…each refueling outage plan will include a Shutdown Risk Assessment."

ORGANIZATION OF PRA PROGRAMS

- Ownership and Champions
  - Executive Level
  - Department Level
  - Division Level
  - Working Level
- Foster development
- Facilitate integration
- Provide continuous improvement

FUNCTIONAL INTEGRATION

- Clear management ownership and endorsement of the PRA function
- The station's PRA mission is defined
- PRA resource/support requirements identified and budgeted
- PRA goals and objectives are part of the station's Business Plan

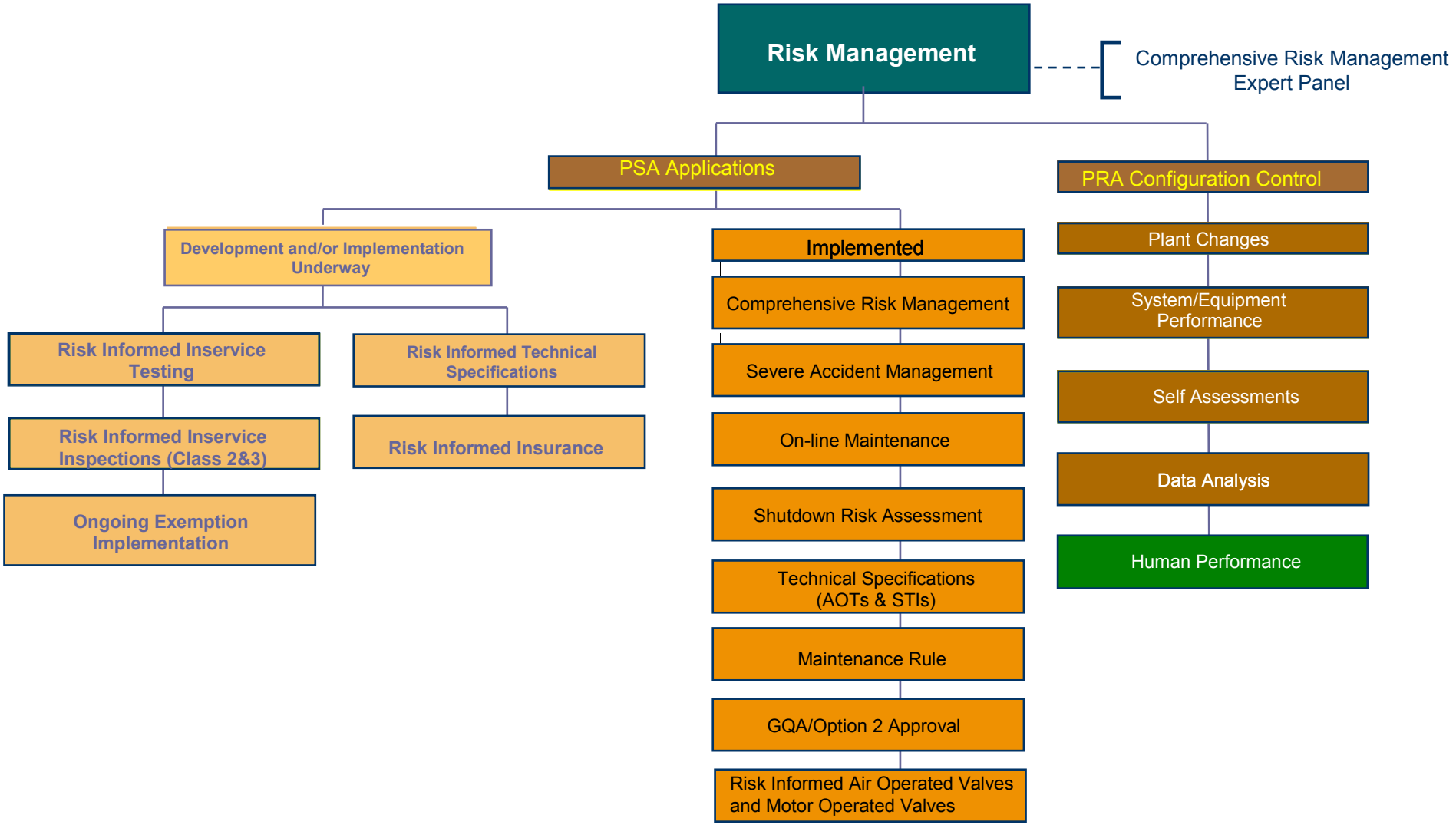
FUNCTIONAL INTEGRATION

- Management expectation of continuous improvement in station risk awareness and level of knowledge
- Incorporation of risk related plant performance indicators for the PRA staff and other key plant organizations

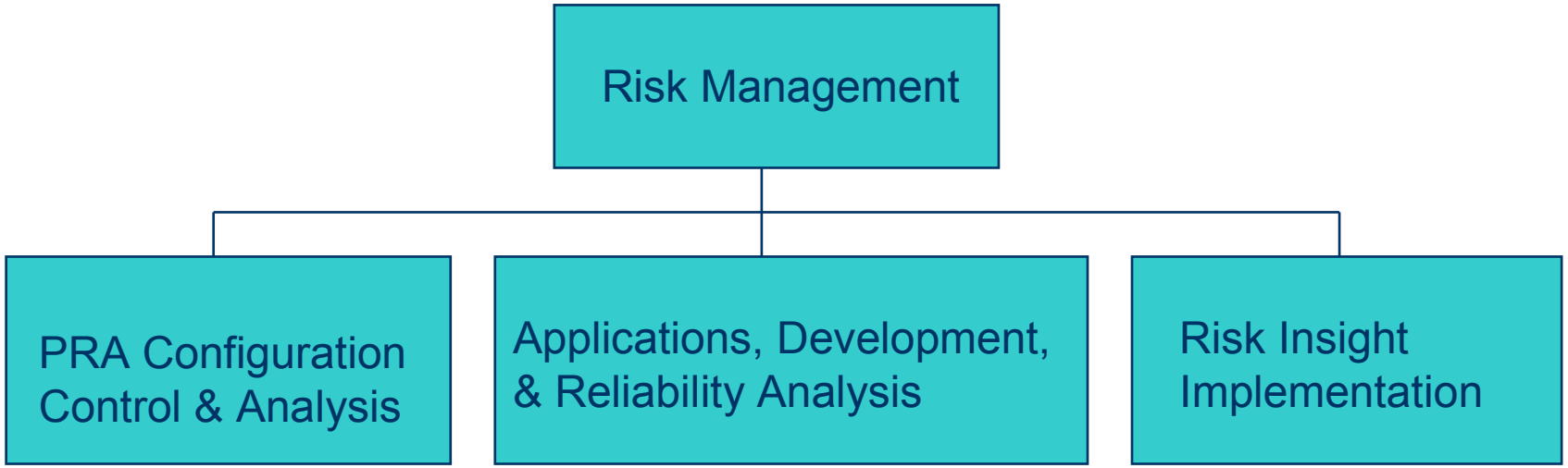
FUNCTIONAL INTEGRATION

- An involved PRA staff actively pursuing improved station and personnel performance through the use of probabilistic methods and techniques

Functional Program Structure



Risk Management Organizational Structure



Risk Management Programmatic Structure

COMPREHENSIVE PRA METHODS/TECHNIQUES

- Scope of PRA
- Level 1 PRA (Core Damage Frequency)
- Level 2 PRA (Radiological Releases)
- Level 3 PRA (Consequences)
- Shutdown Risk Assessment
- Transition Mode PRA
- Balance of Plant
- Enhanced Human Performance Model

COMPREHENSIVE PRA METHODS/TECHNIQUES

- Level of Analysis
- Complete treatment of internal/external events
- Detailed system/plant level modeling
- Human actions (operator/recovery actions)
- Data Analysis, including common cause
- Plant specific performance data
- Uncertainty analyses
- Demonstrated ability to manipulate, evaluate and test all risk models

COMPREHENSIVE PRA METHODS/TECHNIQUES

- Key areas of record and documentation
- Definition of quantitative analysis capabilities
- Detailed descriptions, with retrievable documentation, of employed probabilistic methods and techniques
- Detailed site specific plant level analyses
- Detailed plant specific system level analyses
- Supporting engineering analyses identified, documented, and retrievable
- Assumptions/limitations and areas of uncertainty
- Quantification results and any pertinent sensitivity analyses

IMPLEMENTATION

- PRA baseline functions
  - PSA Scope and Model Development
  - PSA Configuration Control
  - Operational Decision Making/License Issue Resolution
  - Maintenance Rule, Shutdown Risk, Severe Accident Management
  - Verification and validation of PRA software and software tools
- PRA initiative functions
  - Graded QA, Risk Based IST/ISI, etc.
  - Configuration Risk Management (On-Line Maintenance)
  - Technical Specification Optimization
- PRA Training & Tools - Tailored for PRA and plant personnel
- PRA Codes & Standards - ASME RA-S-2002 (dated April 5, 2002)

ASSESSMENT OF AGGREGATE EFFECTS

- Incorporated in Comprehensive Risk Management Programs (CRMP)
- Part of PRA Configuration Control
  - Quantitative PRA evaluation
  - Qualitative evaluation
- Periodic CRMP Expert Panel assessments of plant performance, etc.

ASSESSMENT OF AGGREGATE EFFECTS

- Feedback & Corrective Actions processed
- Incorporation and update into PRA program and associated station programs
- Conclusions and Decision-Making performed relative to overall plant risk impacts

CONTINUOUS IMPROVEMENT

- Transfer of PRA tools to customers
- New uses of PRA identified by customer organizations
- Self-Assessment of PRA programs
- Refining PRA methods and techniques
- Periodic PRA updates
  - Plant design and operational practices
  - Human/Equipment performance data

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.

Comprehensive Risk Management

THE EXPERT PANEL

- 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

Comprehensive Risk Management

EXPERT PANEL MEMBERS

- Generation Support Manager
- Engineering Manager
- Operations Manager
- Quality & Licensing Manager
- Training Manager
- Risk Management Manager

EXPERT PANEL 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/Comprehensive Risk Management Program and adjust program criteria as appropriate.
6. Approve and issue for plant use the Risk Significance Basis Documents.Appoint Working Groups.

Comprehensive Risk Management

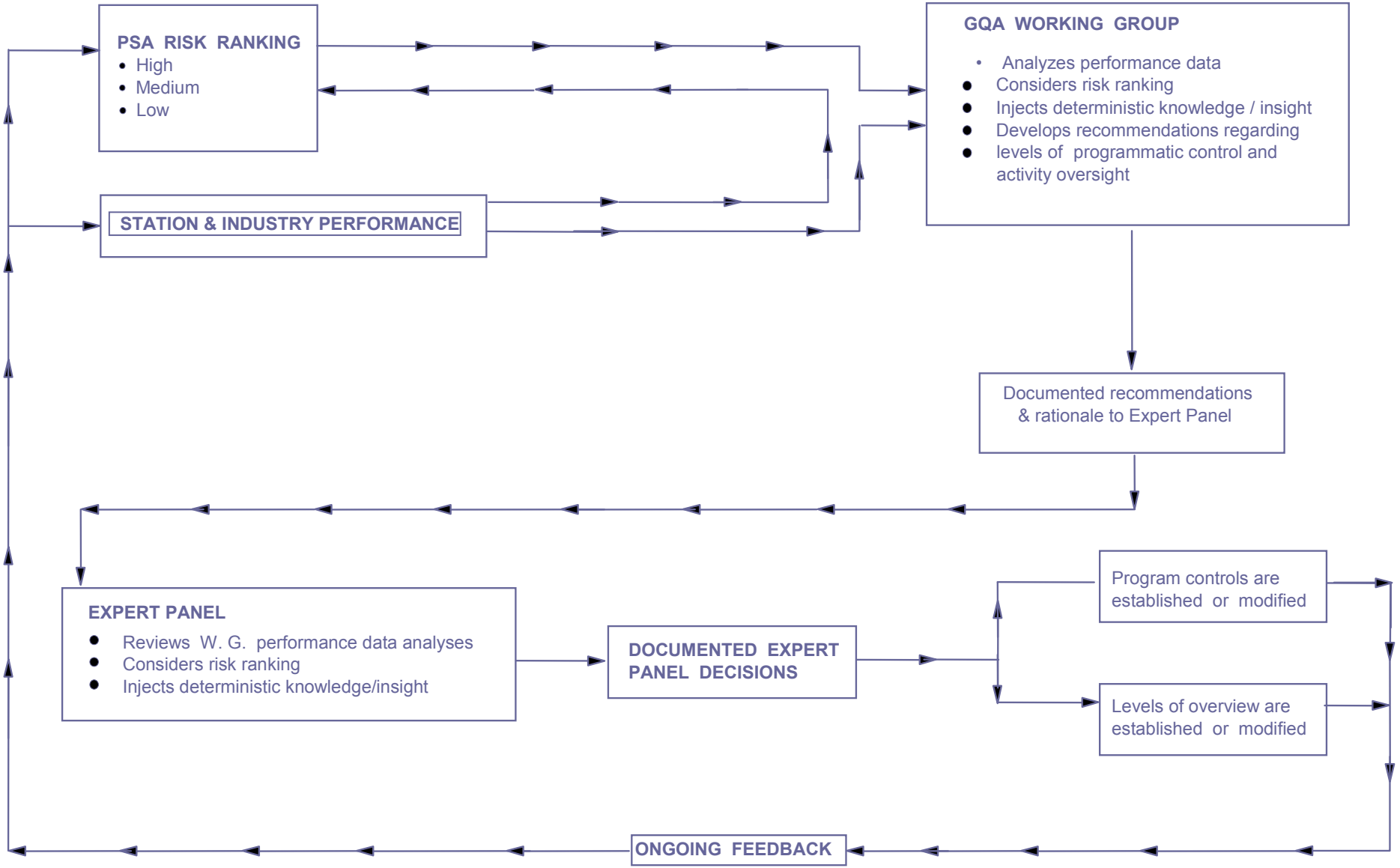
EXPERT PANEL FUNCTIONS

- **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.

Risk Management Applications

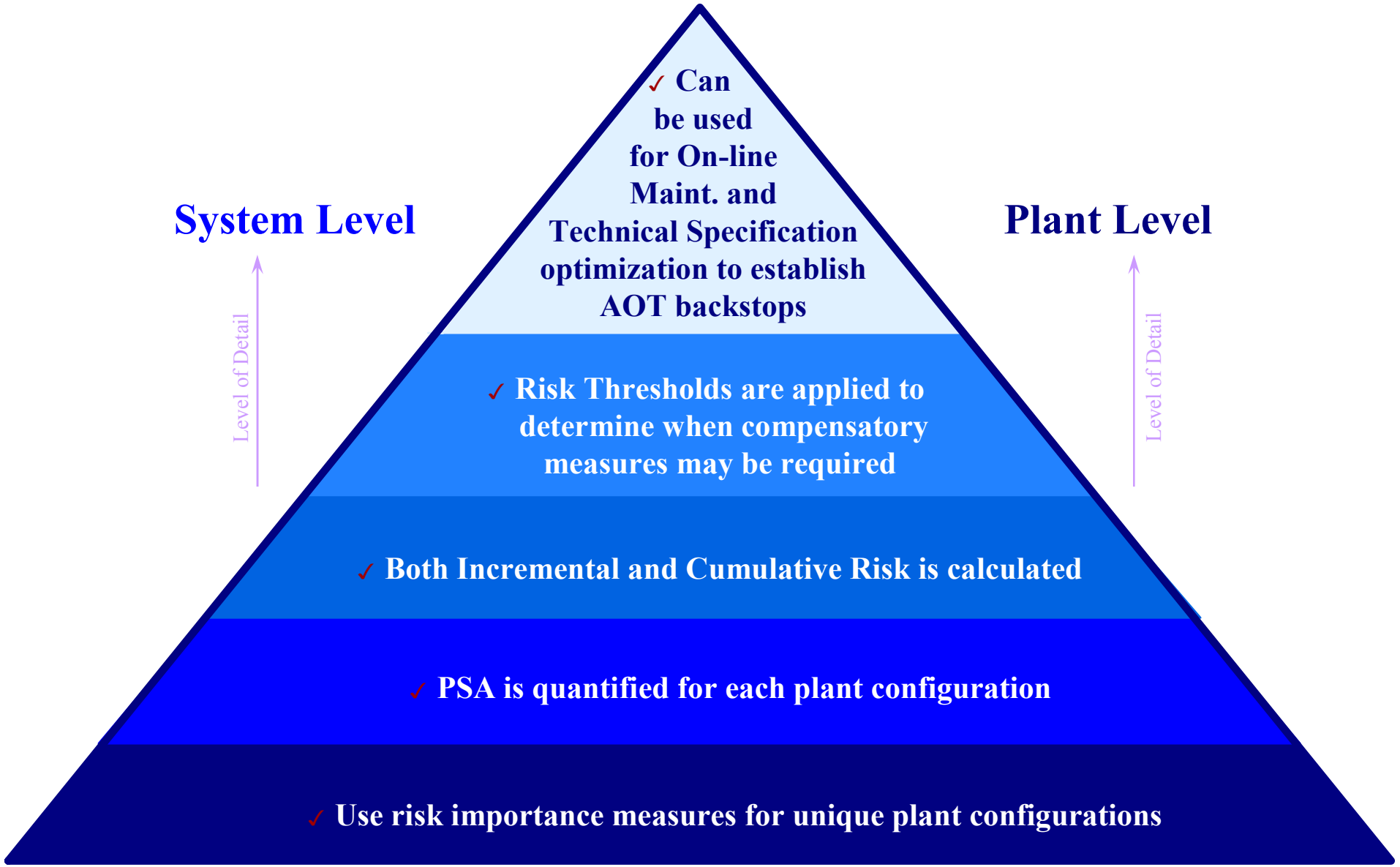
STP Categorization Flowchart



Technical Specification Optimization

- **Purpose -** Establish a technical basis for allowed outage times (AOTs) and surveillance test intervals (STIs) based on safety significance
- **Technical Approach -** AOT durations adjusted and risk impacts evaluated using cumulative and instantaneous threshold limits
- **Results -** Two NRC submittals (1989 & 1995)
  - ➔Selected System AOTs extended from 72 hrs to 7 days or more
  - ➔(DG to 14 days, 24 hours for cross train failures)
  - ➔Increased surveillance test intervals for some affected systems
- **Benefits -** Greatly facilitates On-Line Maint., significant outage scope reduction, Tech Spec forced administrative shutdowns reduced significantly. Safety improvements from increased defense-in-depth of key safety functions during shutdown conditions

Configuration Risk Management Programs



On-Line Maintenance

- **Purpose -** Evaluate the safety impact of equipment removed from service (Configuration Risk Management Program); satisfy 10CFR50.65 (a)(4) of the Maintenance Rule
- **Technical Approach -** Configuration specific evaluations with full Level 1 PRA quantifications incorporated with a graphical user interface designed for control room personnel
- **Results -** Whole plant acceptance of approach, risk tools turned over to user organizations (Work Control, Ops), key station performance indicator for nuclear safety
- **Benefits -** Demonstrates safety levels for on-line work - enables safety levels to be managed and monitored more accurately and robustly than ever before

On-Line Maintenance

- **Incorporated part of 14/7 Day DG/EW Allowed Outage Time change**
- **Configuration Risk Management Program defined in Technical Specifications, Section 6**
- **Defines responsibilities for each group:**
  - Work Control
  - Operations
  - Risk Management
- **Risk thresholds identified for triggering specific station actions**
  - 10^{-6} Threshold, management notification required and consideration development of compensatory measures
  - 10^{-5} Threshold, Duty Plant Manager notified

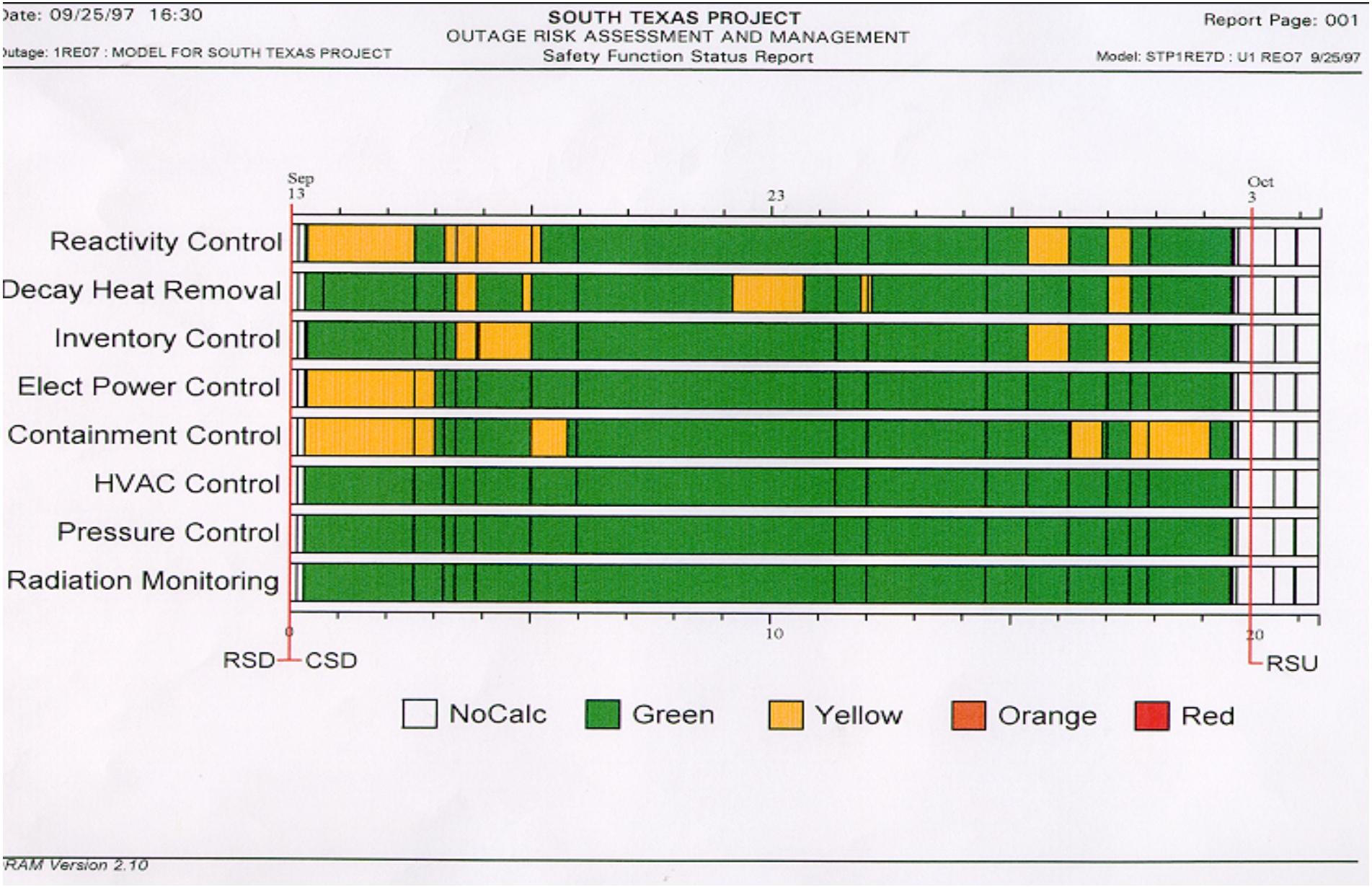
Shutdown Risk Assessment

- **Purpose -** to evaluate risk during shutdown modes and maintain defense-in-depth awareness under frequent plant configuration and schedule changes.
- **Technical Approach -** EPRI ORAM/Riskman® models with user interface with ORAM.
- **Results -** Whole plant acceptance of approach, risk tools turned over to user organizations (Outage) - Key Performance Indicator for Nuclear Safety during shutdown conditions.
- **Benefits -** Demonstrates plant shutdown safety levels maintained low in conjunction with On-Line Maintenance - Outage Safety levels can now be monitored and managed

Shutdown Risk Assessment

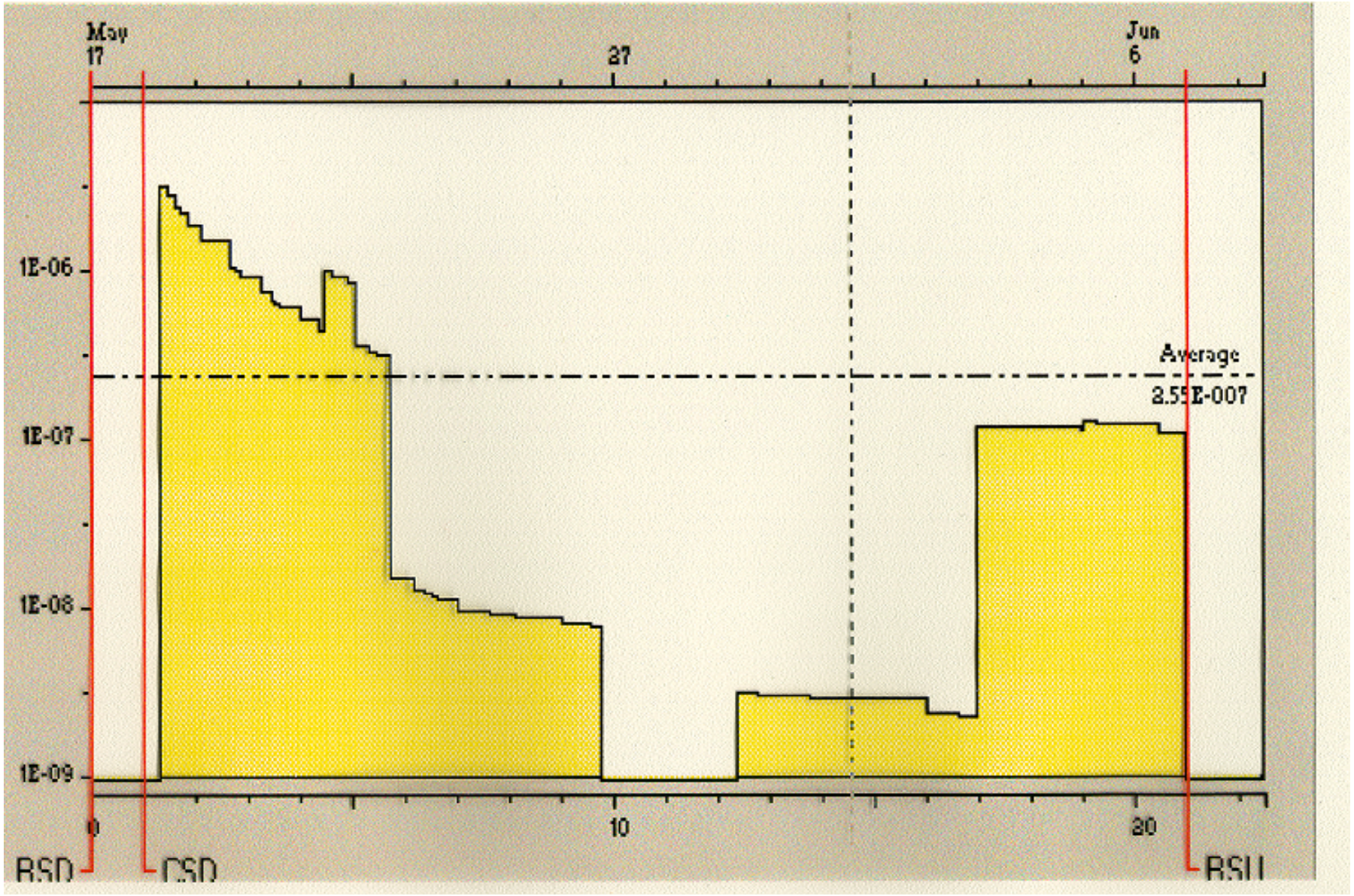
- Shutdown Risk Assessment Group (SRAG) evaluates each refueling outage or as directed by plant management.
- Nuclear Group Policy and Shutdown Risk Assessment Procedure govern program (Policy NGP-181 and Procedure OPGP03-ZA-0101).
- Outage schedules are pre-approved by SRAG and outage progress is monitored by SRAG.
- Shutdown risk levels are also a part of the Outage Incentive Goals.

Shutdown Risk Assessment



Shutdown Risk Assessment

RISK PROFILE



Maintenance Rule

- **Purpose -** Support Maintenance Rule group in monitoring the effectiveness of maintenance
- **Technical Approach -** System/Component Risk significance, establishing performance criteria, balance availability/reliability, & assessment of cumulative effects
- **Results -** Programs developed and implemented
- **Benefits -** Satisfies 10CFR50.65

Emergency Response Organization

- Establish target sets for Station Physical Security Plan & Force-on-Force Drills
- Scenario development for ERO drills & graded exercises
- Level 2 PRA used to establish plant specific Severe Accident Management Guidelines
- Computer generated plant data to support Severe Accident Exercise

Risk Informed Valve Testing Programs

- Risk information used to determine safety significance and appropriate strategies for both motor operated and air operated valve testing programs
- Used Working Groups and Expert Panel to optimize testing programs
- Programs have been implemented on MOVs and AOVs and will be further evaluated to take advantage of STP's special treatment requirement exemptions as appropriate.

Risk Informed Inservice Testing

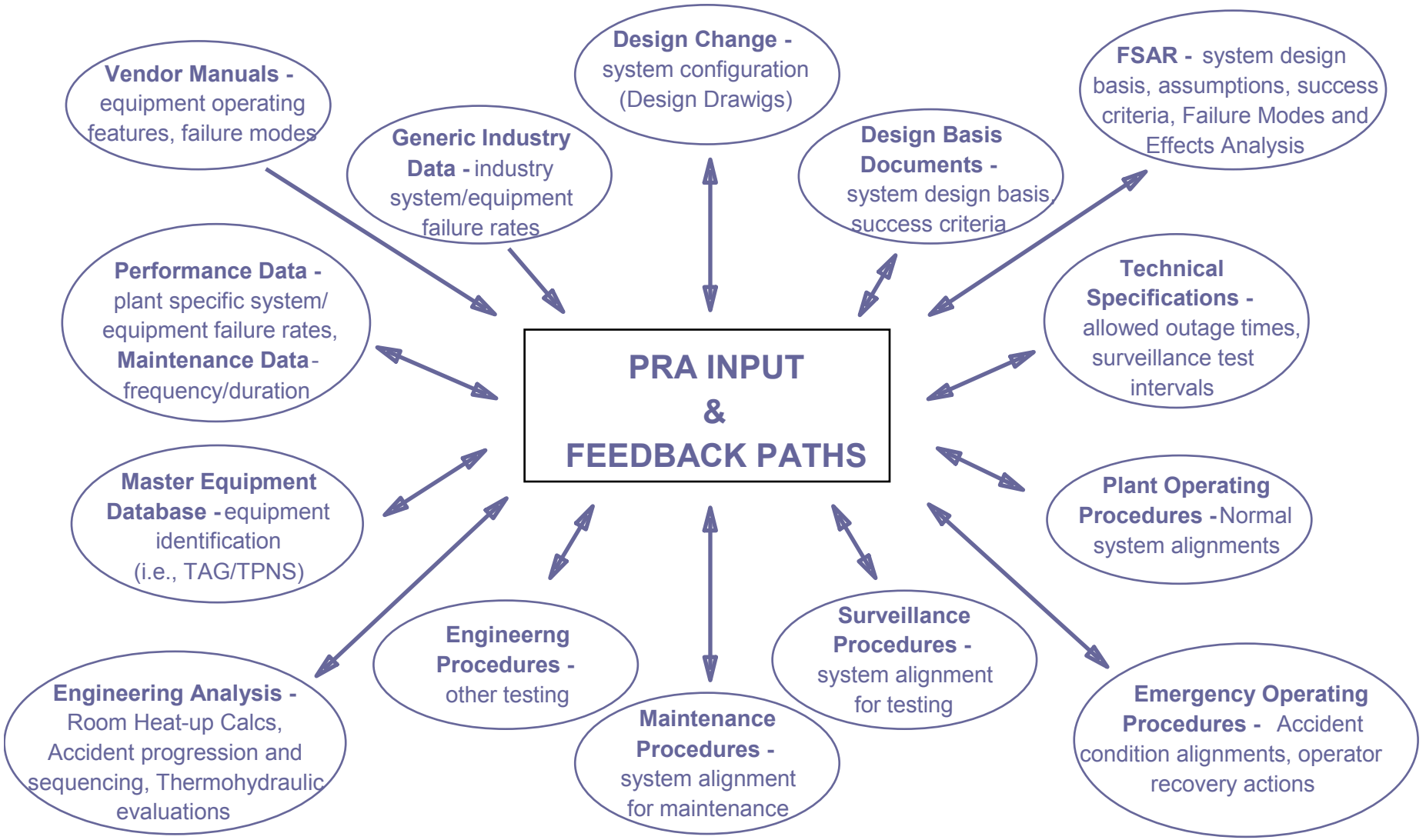
- Risk informed, performance based approach for IST is submitted to NRC in 2000
- Uses experience gained from pilot plants and will be in accordance with IST Reg Guide
- STP's approach uses a Working Group and Expert Panel for approval of IST changes
- Establish new testing strategies and test frequencies based on component importance.

PRA CONFIGURATION CONTROL

PRA CONFIGURATION CONTROL FEATURES

- Process of identifying, evaluating, and dispositioning changes to PRA inputs
- Procedures or Desktop Instructions
- Retrievable Documentation
- Periodic review and update
- Criteria for incorporation of changes
- Continuous baseline activity

PRA INPUT & FEEDBACK PATHS



PROCEDURES & DOCUMENTS

- PRA Program Description
- Procedures or Desktops for key deliverables, such as risk ranking
- Control/updating of implemented PRA applications
- PRA Configuration Control procedure
  - Processing of identifying plant changes
  - Process for dispositioning plant changes relative to PSA impacts

DOCUMENTATION

- System Level Notebooks
- Plant Level (Event Tree) Notebooks
- Methodology Manual
- Supporting databases
- Plant Specific Data Analysis (update of PRA failure data based on plant specific equipment performance history)
- Quantifications of Record

PERIODIC REVIEW & UPDATE

- Formal documented process with time and date stamp
- Written and oral site communication
- Training to key stakeholders
- Re-ranking of dominant contributors
- Integration into implemented PRA applications
- External/internal peer review

PRA CHANGE CRITERIA

- Minor changes - normal processing
  - Little or no change to quantification results
  - Does not impact decision making
  - Does not impact assumptions/limitations
- Major changes - immediate processing
  - Significantly affects quantification
  - Changes PRA success criteria
  - Impacts assumptions/limitations

MONITORING PLANT CHANGES

- Continuous baseline PRA activity to identify both pending and implemented changes
- Pending or pre-decisional changes
  - Changes evaluated prior to approval/implementation
  - PRA information used in decision making process
- In-effect or post-decisional changes
  - Changes evaluated after approval/implementation
  - PRA information used to determine safety/performance impact

CONTROL OF PRA APPLICATIONS

CONTROL OF PRA APPLICATIONS

- Controlled with applicable program procedures
- Clear lines of responsibility and points of contact
- Application updates performed in conjunction with PRA updates
- Expert Panel reviews performed to identify adverse trends

CONCLUDING REMARKS

CONCLUDING REMARKS

- PRA is a tool for decision-making
- PRA changes traditional approaches by applying graded strategies based on importance
- It is an analytical tool for developing unbiased trends to improve performance at complex engineered facilities

CONCLUDING REMARKS

- PRA is an emerging discipline; it's important to be well grounded in its technical methods, assumptions and limitations
- When applied properly, it is a management and station strength improves performance and reduces risk