# Using a Standardized Tool for Risk-Informed Inspection of Nuclear Power Plants

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# Commercial Nuclear Power Plants

- US Nuclear Regulatory Commission (NRC) ensures adequate protection of public health and safety in the peaceful uses of nuclear materials, including nuclear power plants (NPPs)
- 99 NPPs are currently in operation
- NRC has a rigorous process for licensing plants and provides continuous oversight of plant operations
- NRC has developed and uses probabilistic risk assessment (PRA) tools in many of its regulatory activities

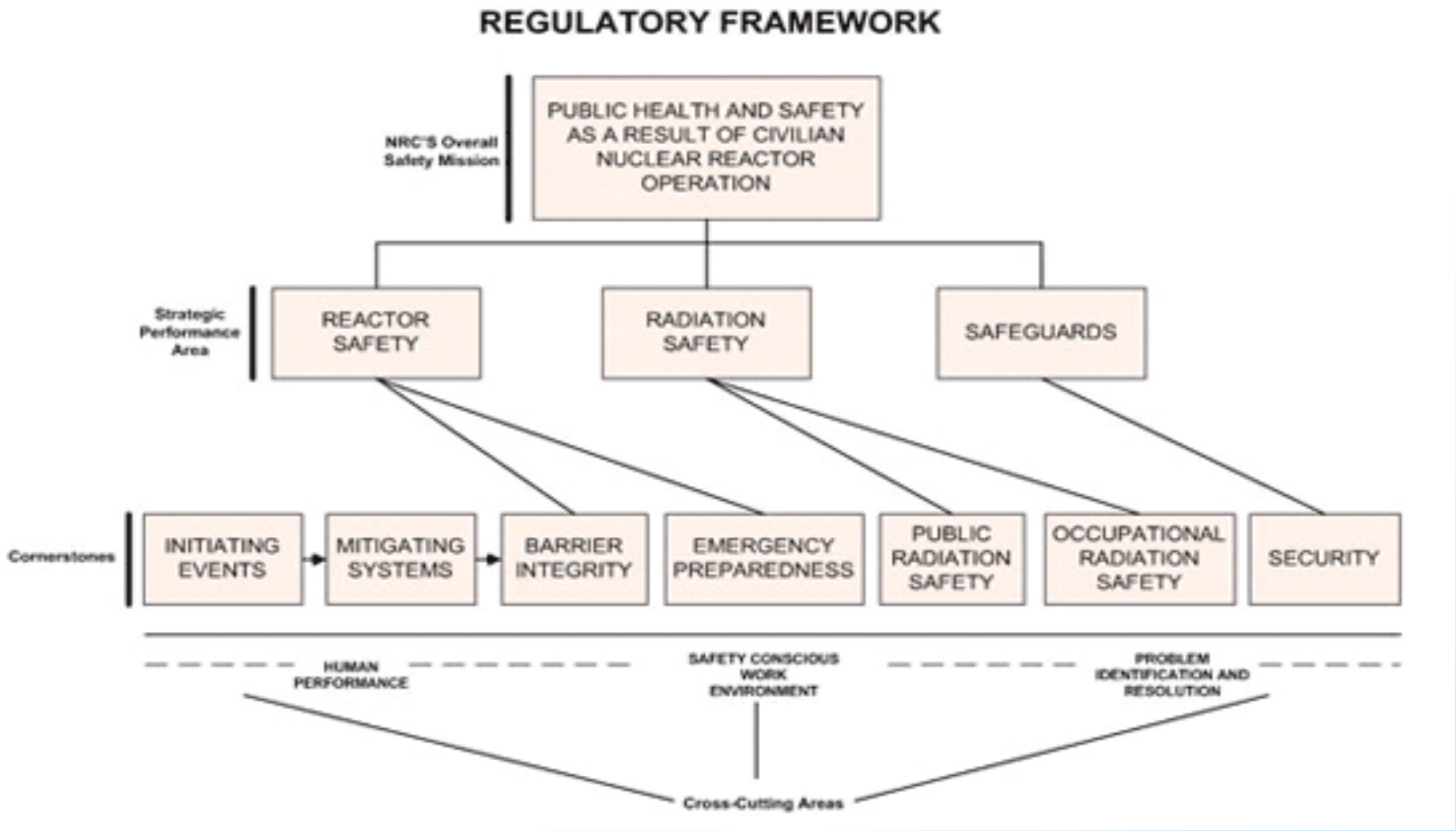
# Use of Risk Information in NRC Activities

- NRC conducted PRAs of nuclear units supporting development of methods, tools, and guidance
- All operating NPPs have completed plant-specific PRAs and have identified many uses
- NRC established safety goals and policy statement on use of PRA
- NRC has extensive programs supporting risk analyses, data collection, and use of risk insights
- NRC revised its oversight process with a risk-informed reactor oversight process (ROP)

# Reactor Oversight Process

- Focusing inspection on activities where the potential for risks are greater
- Greater regulatory attention to plants with performance problems; normal level for facilities that perform well
- Responding to violations in a predictable and consistent manner that reflects the potential safety impact
- Giving public and nuclear industry timely and understandable assessment of plant performance

# Framework for USNRC's Reactor Oversight Process



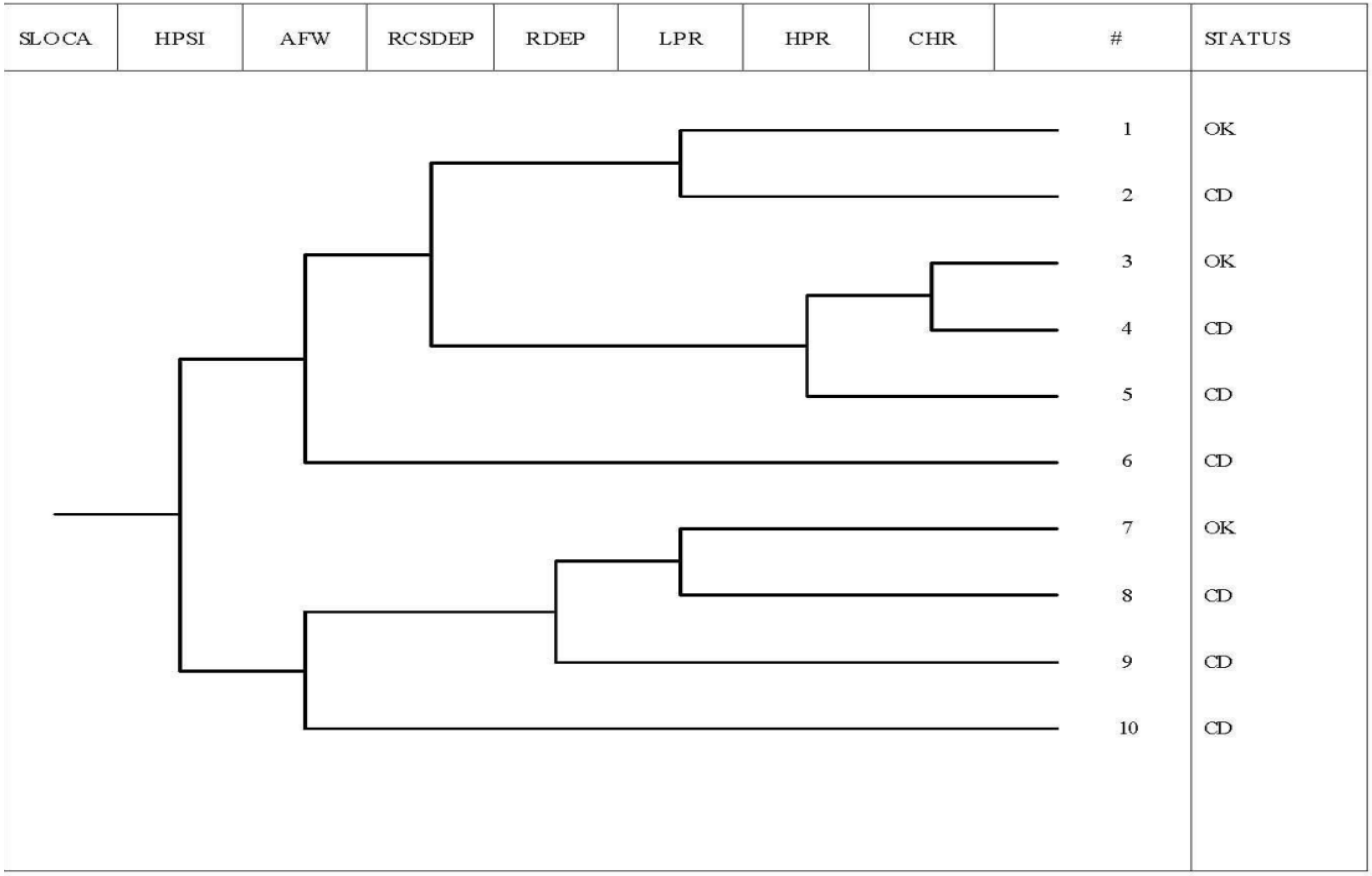
# Use of Standardized Tools to Conduct Risk Assessment

- A methodology for relating inspection findings to its risk implications
- Order of magnitude determination
- Assigns risk values to inspection findings in terms of colors (red, yellow, white, and green)
- Termed “Significance Determination Process (SDP)”
- SDP Phases:
  - Initial screening
  - Risk significance approximation
  - Risk significance finalization and justification

# Modeling Considerations in Standardized Tools to Assess Risk Significance

- Bringing together a variety of plant-specific PRA models using a consistent modeling approach
- Consistent modeling assumptions with due credit to plant-specific features
- Use of engineering terminology facilitating use by the inspectors
- Quick order of magnitude assessment of inspection findings to resolve majority of the cases
- Can be used to select risk-informed features for inspection

# Example Event Tree



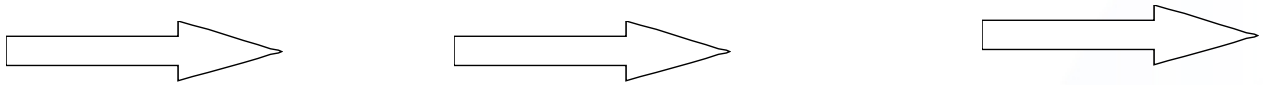
# Example SDP Worksheet

| Safety Functions Needed: | Full Creditable Mitigation Capability for Each Safety Function: |
|---|---|
| High Pressure Safety Injection (HPSI) | 1/2 HPSI trains through three injection lines (1 multi-train system) |
| Auxiliary Feedwater (AFW) | [1/1 essential AFW MDP B or 1/1 non-essential AFW MDP Train X [3]] (1 multi-train system) or 1/1 AFW TDP A (1 ASD train)] |
| RCS Depressurization (RCSDEP) | Operator depressurizes RCS using 1/8 TBVs or 1/4 ADVs (operator action = 2) [4] |
| Rapid RCS Depressurization (RDEP) [5] | Rapid cooldown and depressurization (using 2/4 ADVs or 1/8 TBVs) with 4/4 SITs followed by 1/2 LPSI MDPs (operator action = 1) [6] |
| Low Pressure Safety Recirculation (LPR) | 1/2 LPSI MDPs taking suction from the containment sump (operator action = 3) [7] |
| High Pressure Safety Recirculation (HPR) | 1/2 HPSI trains taking suction from the containment sump (1 multi-train system) |
| Containment Heat Removal (CHR) [2] | 1/2 CS MDPs for containment spray with associated SDC heat exchanger (1 multi-train system) [8] |

| Circle Affected Functions | | IEL | Remaining Mitigation Capability Rating for Each Affected Sequence | Recovery Credit | Results | LERF Factor |
|---|---|---|---|---|---|---|
| 1 SLOCA - RCSDEP - CHR (4)<br>3 + 2 + 3 | 8 | | | | | 0 |
| 2 SLOCA - LPR (2, 8)<br>3 + 3 | 6 | | | | | 0 |
| 3 SLOCA - RCSDEP- HPR (5)<br>3 + 2 + 3 | 8 | | | | | 0 |
| 4 SLOCA - AFW (6, 10)<br>3 + 4 | 7 | | | | | 0 |
| 5 SLOCA - HPSI - RDEP (9)<br>3 + 3 + 1 | 7 | | | | | 0 |

# Action Matrix Concept

| Licensee Response | Regulatory Response | Degraded Cornerstone | Multiple/Rep. Degraded Cornerstone | Unacceptable Performance |
|---|---|---|---|---|



Performance Based Oversight
Increasing Safety Significance
Increasing NRC Inspection Efforts
Increasing NRC/Licensee Management Involvement
Increasing Regulatory Actions

# Tools Development for Implementation of ROP

- Safety cornerstones and inspectable areas
- Guidance for conducting inspections in inspectable areas
- Summary risk insights for inspection focus on risk-significant aspects
- Plant-specific models for significance determination process (SDP)
- Inspection guidance documents for different aspects in the ROP

# Risk informed approaches for pipeline safety

- Many NTSB recommendations focus on risk approaches to address relevant issues
- NTSB recommendations can be addressed through development of risk-informed approaches
- Significant improvement in NRC processes and NPP safety through use of risk-informed approaches
- Gas transmission pipeline operational safety can benefit adapting and using the lessons from the risk technology