

# Conduct of Operations For the 21<sup>st</sup> Century

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Defense Nuclear Facilities Safety Board**

**2018 DOE Nuclear & Facility Safety Programs Workshop  
May 2018**

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# Recently Reported in ORPS

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- 03/02/2017 LANL-TA55, DSA Non-compliance
- 04/10/2017 Hanford-TF, TSR Non-compliance
- 04/26/2017 SRS-TRIT TSR Non-compliance
- 09/19/2017 Idaho-AMWTF, TSR Non-compliance
- 09/27/2017 Idaho-AMWTF, Criticality Working Requirement Violation
- 11/15/2017 Y-12, TSR Non-compliance
- 11/16/2017 LANL-TA55, Criticality Safety Posting Non-compliance
- 12/19/2017 Pantex, TSR LCO Not Entered
- 01/17/2018 Pantex, TSR Non-compliance
- 01/18/2018 Y-12, Inadequate TSR surveillance
- 02/07/2018 Hanford-Waste, TSR Non-compliance
- 03/03/2018 SRS-WVIT, Failure to Enter LCO
- 03/06/2018 Hanford-PFP, TSR SAC Non-compliance



# Conduct of Operations

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**The health and safety of the public and the workers rest on a properly trained workforce accomplishing tasks in a formal deliberate fashion in accordance with reviewed and approved procedures.**

**As a result, many of the Board's recommendations have stressed training and conduct of operations.**

Fourth Annual Report to Congress  
DNFSB, February 1994



# Board History on Operations

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The Board issued 11 Recommendations and 7 Technical Reports involving Conduct of Operations

- |         |  |      |  |
|---------|--|------|--|
| 90-2    | <i>Codes and Standards</i>   | 94-5 | <i>Integration of DOE Safety Rules, Orders, and Other Requirements</i>                         |
| 91-1    | <i>Safety Standards Program</i>  | 95-2 | <i>Safety Management</i>   |
| 92-2    | <i>Facility Representatives</i>  | 98-1 | <i>Integrated Safety Management and the Department of Energy Facilities</i>                    |
| 92-5    | <i>Discipline of Operations in a Changing Defense Nuclear Complex</i>  | 02-3 | <i>Requirements for the Design, Implementation, and Maintenance of Administrative Controls</i> |
| 92-7    | <i>Training and Qualification</i>  | 04-1 | <i>Oversight of Complex, High-Hazard Nuclear Operations</i>                                    |
| 93-3    | <i>DOE Technical Capability in Defense Nuclear Facilities Programs</i>   |      |  |
| TECH-5  | <i>Fundamentals for Understanding Standards-Based Safety Management of Department of Energy Defense Nuclear Facilities</i> |      |  |
| TECH-6  | <i>Remarks on Safety Management and Conduct of Operations at the Department Of Energy's Defense Nuclear Facilities</i>     |      |  |
| TECH-15 | <i>Operational Formality for Department of Energy Nuclear Facilities and Activities</i>                                    |      |  |
| TECH-16 | <i>Integrated Safety Management</i>  |      |  |
| TECH-35 | <i>Safety Management of Complex, High-Hazard Organizations</i>   |      |  |
| TECH-36 | <i>Integrated Safety Management: The Foundation for an Effective Safety Culture</i>  |      |  |
| TECH-37 | <i>Integrated Safety Management at the Activity Level: Work Planning and Control</i>                                       |      |  |



# Why Conduct of Operations?

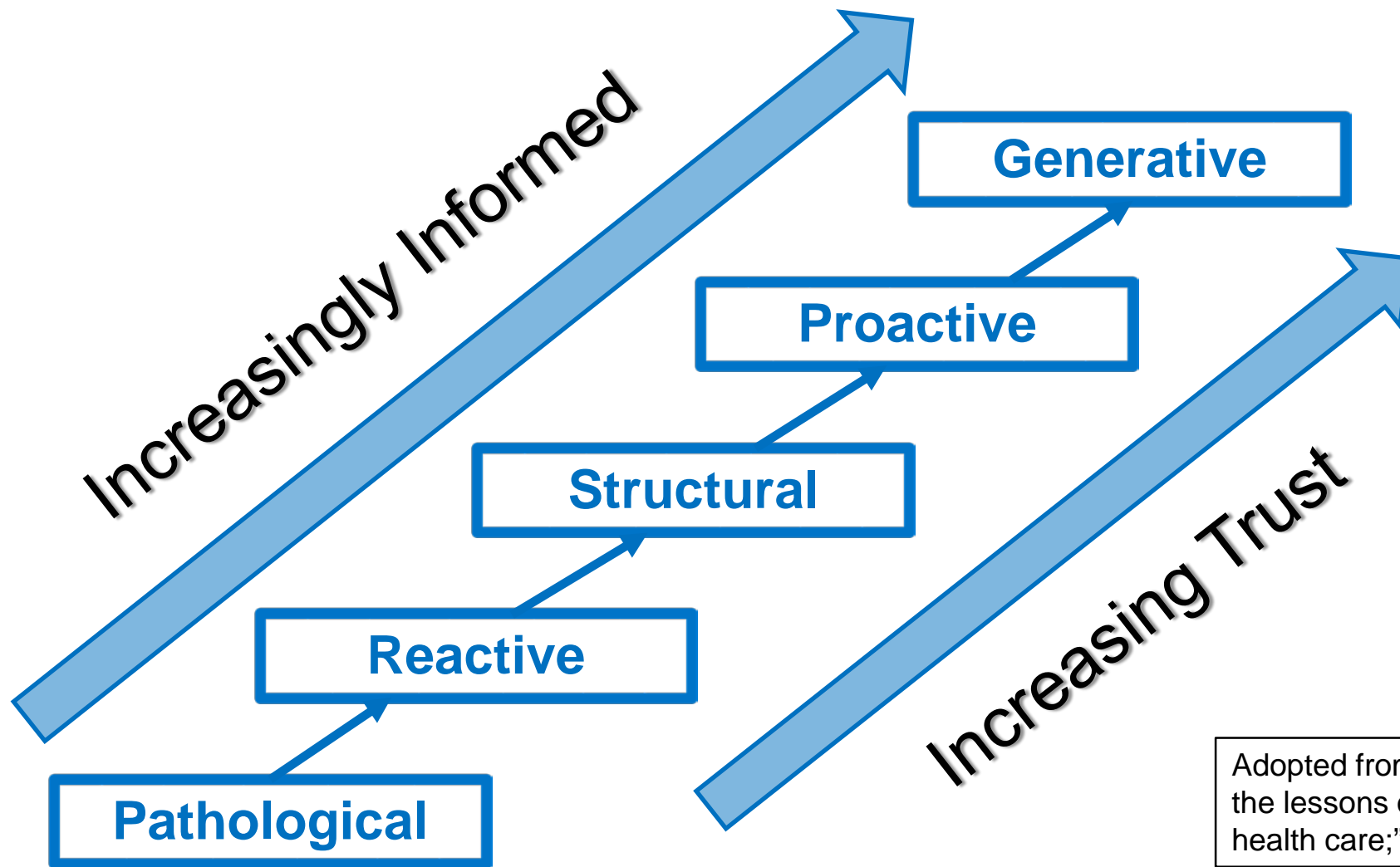
Accidents occur when conditions are rife with:

- Strong budget and production pressures
- Functional gaps from organizational changes
- Over-confidence that leads to complacency
- Failure to follow the group's own rules
- Ineffective oversight and issues management
- Acceptance of minimal standards of practice
- Unrecognized accumulation of residual risks
- Inherent conflicts in interests or priorities





# The Evolution of Safety



Adopted from P. Hudson, "Applying the lessons of high risk industries to health care;" 2003.



# Safety Maturity Attributes

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- **Pathological:** Opinion-based safety; few standards of practice; very little oversight  
**corrective actions based on disciplinary action**
- **Reactive:** Expert-based safety; accident investigations & audits  
**corrective actions based on procedure revision and retraining**
- **Structural:** Safety management systems; **conduct of operations**; collection of metrics; hazard recognition and control; incident investigations  
**corrective actions based on issues management**
- **Proactive:** Exemplary leadership; management of culture; feedback and improvement; predictive safety analysis techniques; hierarchy of controls  
**corrective actions based on organizational learning**
- **Generative:** Inherent safety; interactive process auditing, quality assurance, and risk management; transparent decisions; aligned rewards systems  
**corrective actions based on continuous improvement**

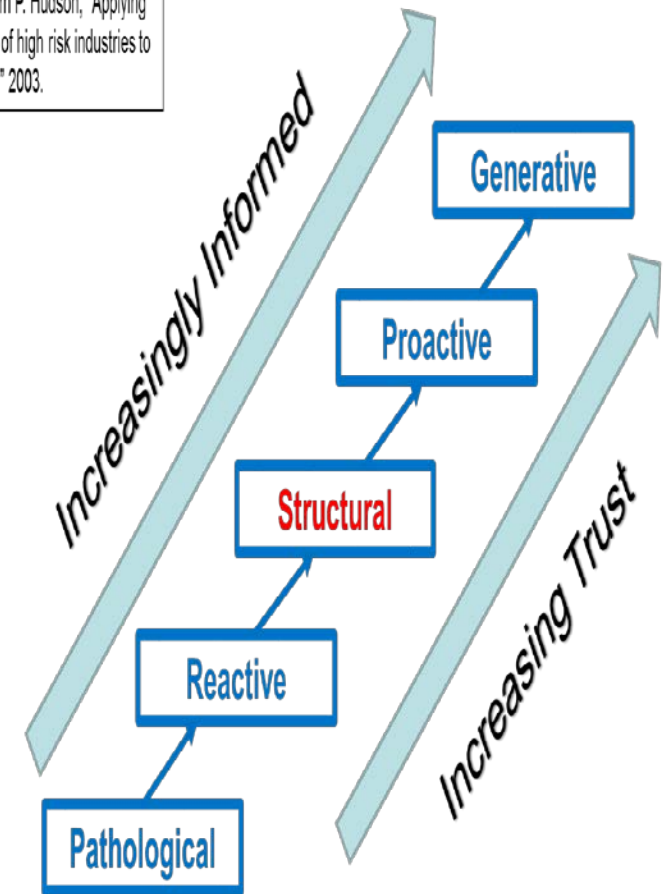


# Board Influence on Safety Maturity



- 10 Recommendations established the Reactive Stage:
  - Establishing, improving, and using safety standards
  - Ensuring compliance with requirements and standards
  - Improving technical competency, training, and qualification
- 16 Recommendations guided DOE into the Structural Stage:
  - Establishing integrated safety management systems
  - Improving hazard analysis methods and safety controls
  - Strengthening oversight and issues management processes
- 2 Recommendations initiated move toward the Proactive Stage
  - Establishing standards for quantitative risk assessment
  - Encouraging a structural approach to managing culture
- No Recommendations address the Generative Stage

Adopted from P. Hudson, "Applying the lessons of high risk industries to health care," 2003.







# Challenges to Operations

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As illustrated, the Board has a long history of effort in encouraging Conduct of Operations within DOE

DOE now faces new challenges to its operations that suggest a need to refresh the concepts and renew the commitment to Conduct of Operations

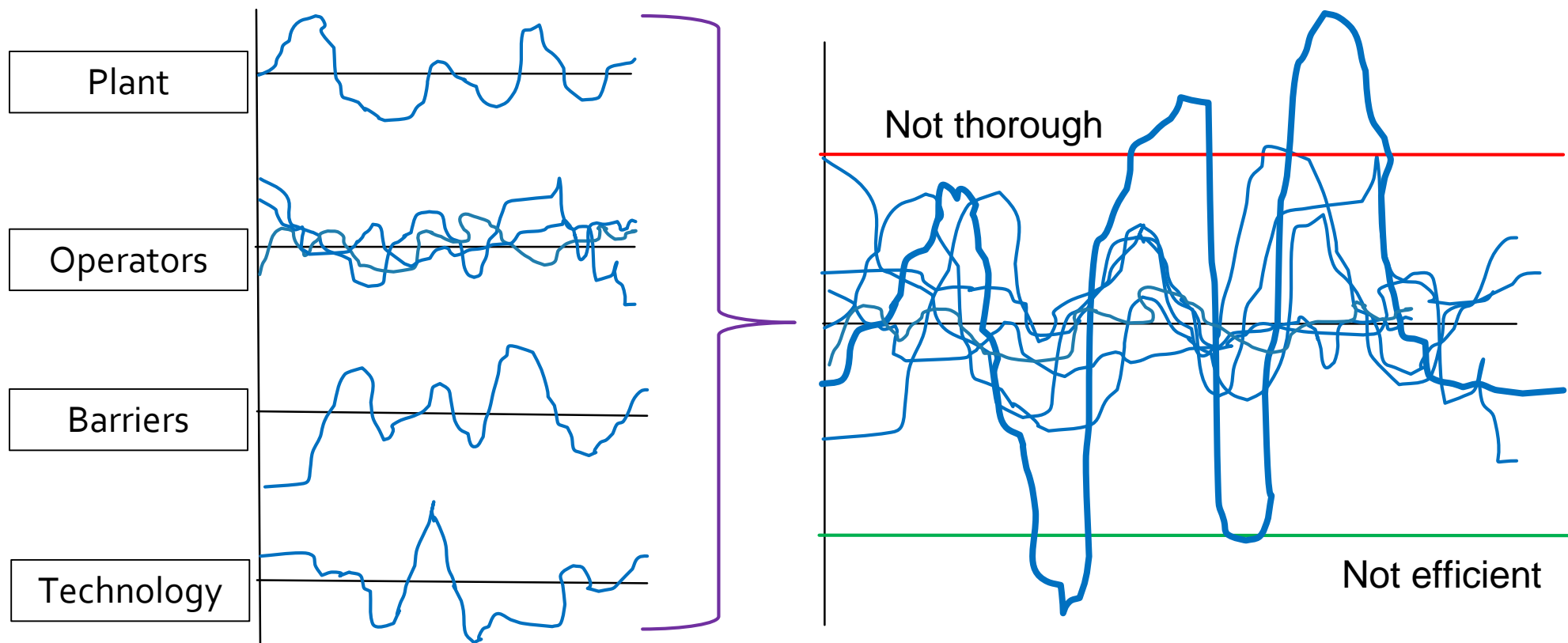
- Frequently changing missions, priorities, and budgets
- Aging infrastructure and extension of facility lifetime
- Changing workforce and increased staff turnover



# Why Worry?

All elements of work have inherent performance variability

Work is conducted within resonances of that variability



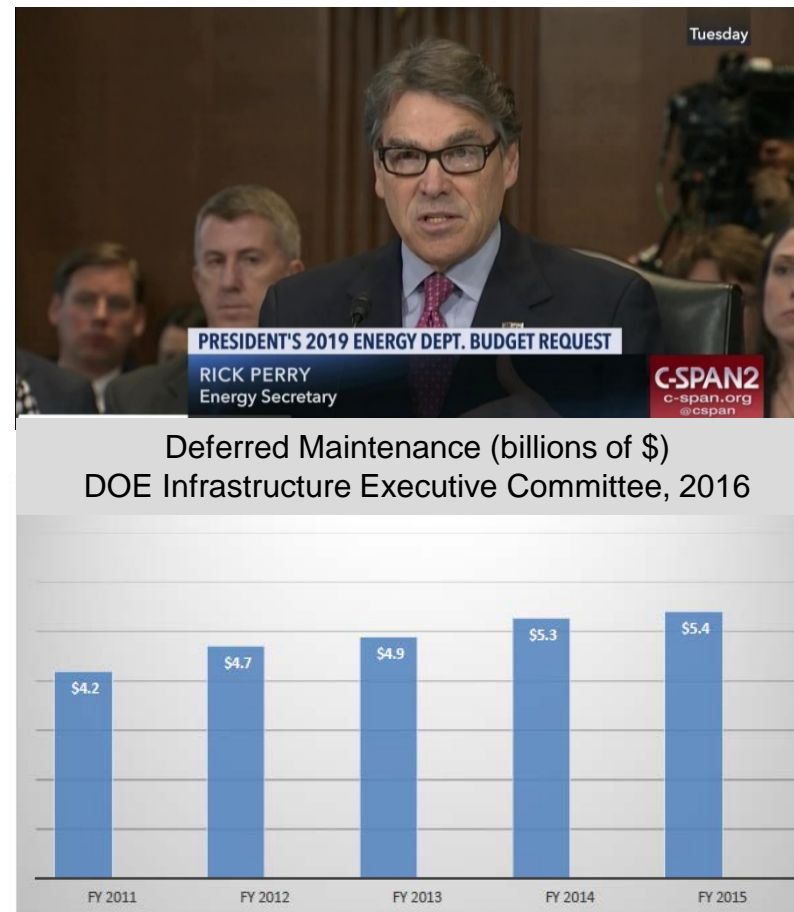
Adopted from: E. Hollnagel; *Barriers and Accident Prevention*; Ashgate Publishing Co.; Aldershot, UK. 2004.



# Changing missions and budgets

## Frequent changes in missions, budgets, priorities, and leadership may lead to increases in performance variability

- Increases tendency to defer maintenance, upgrades, and repair; and run to failure
- Encourages use of facilities for purposes outside original intent and beyond design lifetime
- Decreases funding of overhead activities such as surveillance, oversight, and institutional support
- Necessitates frequent shifts in workforce levels, skills, and abilities
- Creates an air of uncertainty and increases stress and turnover rates within workforce





# Aging Infrastructure

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## **An aging infrastructure can create day-to-day fluctuations in facility conditions and increase performance variability**

- Increases demand and urgency on maintenance personnel
- Encourages acceptance of lower standards in infrastructure performance (normalization of deviance)
- Increases housekeeping needs
- Reduces facility resilience and availability
- Challenges safety system reliability
- Interferes with safe conduct of work
- Increases potential for errors
- Reduces morale in workers due to sub-standard working conditions

"Safe, reliable and modern infrastructure at the National Nuclear Security Administration's national laboratories and production plants is absolutely essential to the accomplishment of our vital national security missions."

-NNSA Administrator Lt. Gen. Klotz

"The primary concern with knowingly deferring maintenance is that a major, unforeseen failure could occur."

-Morgan Smith, CNS

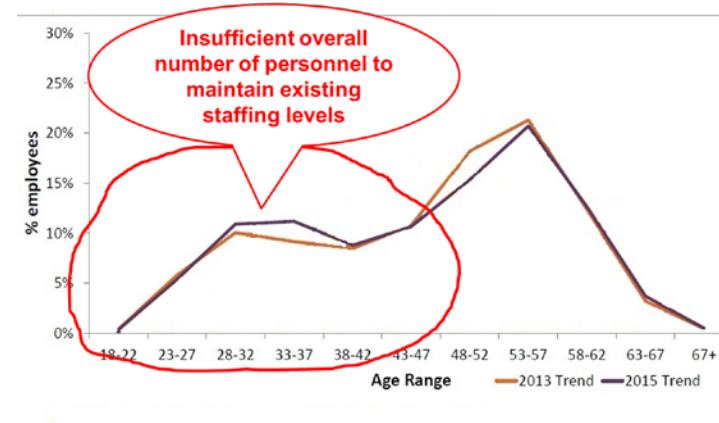
House Subcommittee on Strategic Forces, 2016



# Changing Workforce

## The changing workforce may represent the biggest challenge to the control of performance variability

- Reduces aggregate level of experience and expertise in facilities and processes
- Increases reliance on institutional procedures and engineered and administrative controls
- Increases demands for new worker training and qualification
- Strains career and leadership development pipelines
- Increases need for rigorous oversight
- Promotes interest in process efficiency and automation
- Reduces staff available for institutional support and safety functions
- Generational changes introduce new learning styles and value systems into the organizational culture



Source: Nuclear Energy Institute's 2015 Nuclear Workforce Survey



# What is a Path Forward?

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**The Board's Technical Report 15 identified three underlying concepts for successfully implementing a formality of operations program:**

- **SAFETY CULTURE:** An established safety culture is distinguished by both attitudes and accepted practices. It governs the actions and interactions of all individuals and organizations engaged in hazardous activities.
- **DEFENSE IN DEPTH:** Defense in depth provides an overall strategy for safety measures and features. When properly applied, it ensures that no single human or mechanical failure would lead to injury, and even combinations of failures that are only remotely possible would lead to little or no injury.
- **FRAMEWORK OF CONTROLS:** Operations are conducted within a framework of controls intended to preserve the designed-in capability of structures, systems, and components important to safety and protection of the environment.





# Why Conduct of Operations?

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- **Focusing on Safety Culture**
  - Improves quality of workforce and management decision-making
  - Helps in assimilating new workers into organizational culture
  - Reduces performance variability in the operators
- **Focusing on Defense-in-Depth**
  - Improves resiliency in engineered controls and infrastructure
  - Relieves dependency on administrative controls
  - Reduces performance variability in plant and barriers
- **Focusing on Framework of Controls**
  - Improves confidence in suitability of the controls selected
  - Aids in adapting controls to changing workplace conditions
  - Reduces performance variability in all elements relied on for safe operations



# Other Challenges?

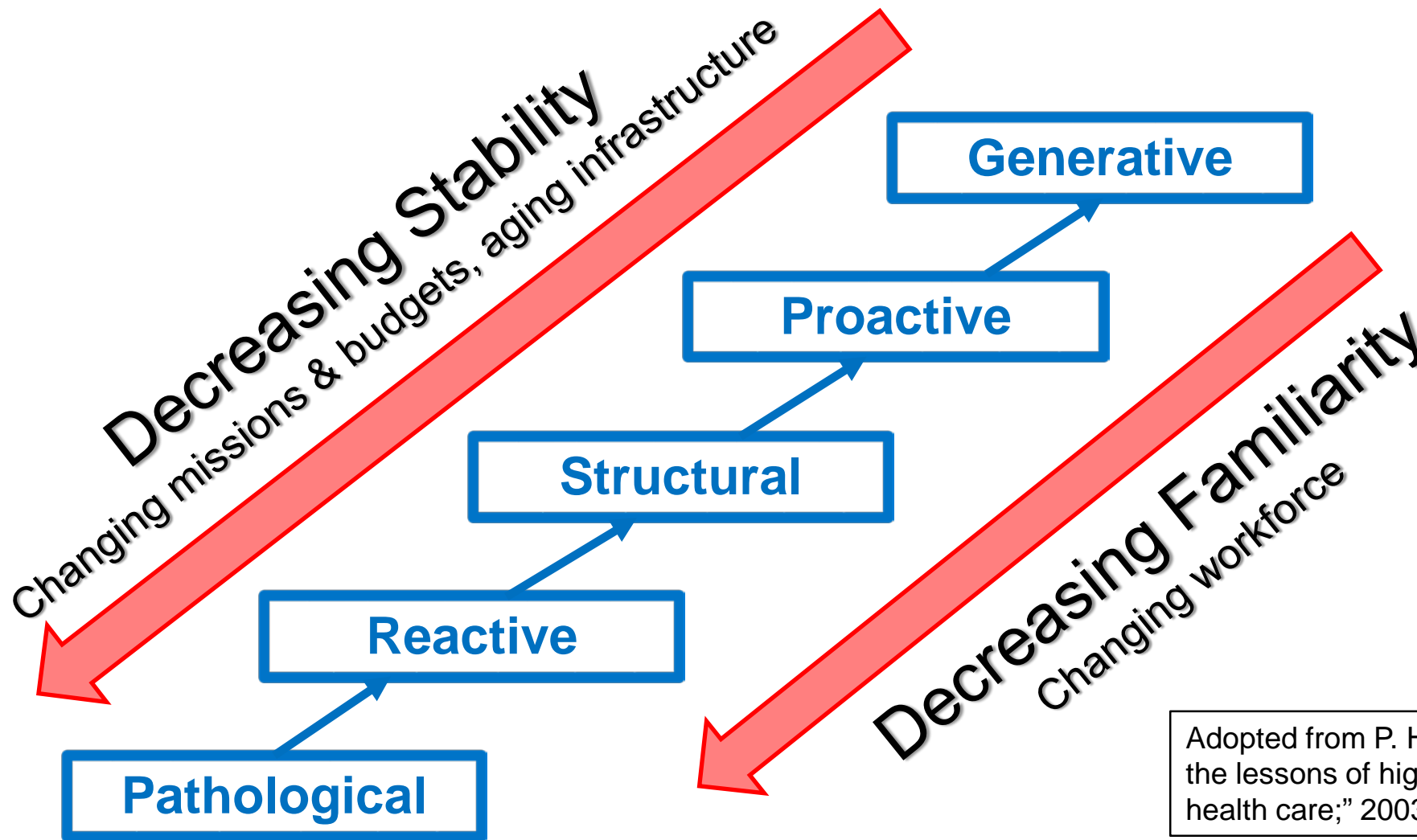
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**Recommendation 2004-1, *Oversight of Complex, High-Hazard Nuclear Operations*, noted that:**

- Proposed modifications to DOE and NNSA's organizational structure, manpower, contract management, oversight policies and practices, and safety directives could have unintended consequences.
- These include reduction of defense in depth, potentially inconsistent safety-related decisions caused by decentralization of safety authority, emphasis on performance as opposed to safety, and reduction of technical capability at key points in the organizational structure.
- DOE and NNSA line managers could be left with inadequate awareness of safety issues.
- **[An organization] needs to be sure that any fundamental reorganization does not degrade nuclear safety, and that the likelihood of a serious accident, facility failure, construction problem, or nuclear incident will not be increased as a result of well-intentioned changes.**



# The Devolution of Safety



Adopted from P. Hudson, "Applying the lessons of high risk industries to health care," 2003.



# Change Management

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Organizational Change Management is a framework for managing the impacts of new processes, changes in organizational structure, or cultural changes within an enterprise.

- As organizations and their practices change, safety documents, procedures, safety functions, roles, and responsibilities should be properly maintained
- Impacts of changes in mission, priorities, budget, and leadership should be formally analyzed and understood prior to implementation
- Managers, supervisors, and workers should be alert to changing conditions and promptly communicate observations to superiors
- Senior leaders should promptly evaluate and act on reports of changing conditions
- Minimum staffing levels should be determined and maintained
- Training programs should be frequently reviewed for appropriateness of content and quality of presentation



# Where to Begin?

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- Lessons learned from emerging events should be developed, disseminated, and acted on; for example:
  - TSR and specific administrative control concerns at SRS
  - Emergency planning and response concerns at LANL and Pantex
  - Corroding and exploding waste drums at INL
  - PFP contamination event and PUREX tunnel collapse at Hanford
- Consider enterprise-wide strategies and guidance for attracting and developing the next generation workforce
- Implement knowledge management programs to capture corporate knowledge of senior staff and disseminate to newer staff
- Consider enterprise-wide strategies and guidance for dealing with aging infrastructure
- Refresh Conduct of Operations programs to ensure they continue to proactively support the safe conduct of work
- Implement Organizational Change Management programs



# Conclusion

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**Each decision, taken by itself, seemed correct, routine, and indeed, insignificant and unremarkable.**

**Yet in retrospect, the cumulative effect was stunning.**

*(Columbia Accident Investigation Board)*





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