Top Events in Regulatory History

Thomas Wellock
NRC Historian

What engineers can teach a historian about history.

The Retirees' List

- Power Reactor Development Corp case (1961)
- TMI
- Browns Ferry
- Davis-Besse Aux. Feedwater Event
- SG Tube Rupture—Ginna, No. Anna, Davis Besse
- Davis-Besse Vessel Head and inspection issues
- Thermo-lag issue
- QA at Zimmer, Comanche Peak, Waterford, TVA
- NEPA and Calvert Cliffs
- WASH-1400 and PRA use
- Late-filed allegations
- Seabrook licensing delays
- Deregulation
- Rise of cyber threats.
- Proactive Enforcement, Individual Responsibility
- Safety Culture
- Whistleblower protections
- Environmental qualifications after 1978 electrical connector event.
- 9/11 and security. orders.
- Millstone and Maine Yankee performance leading to ROP
- Fukushima, Flex and External Events
- Northeast blackout/FERC oversight of grid

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The Retirees List (page 2)

- Backfit rule (1980s)
- Maintenance Rule
- Part 52 and COL
- Risk-informing fire safety
- ASLB decision that DOE could not withdraw Yucca Mtn. application
- Hurricane Andrew: Coordinated plant startups after regulatory holds.
- SONGS SG and Crystal River containment closures.
- INPO and Peach Bottom
- Plants with licensing issues—Diablo, Midland, Watts Bar.
- Shoreham closure
- Peach Bottom IGSCC (1983) leading to NDE expansion
- Peach Bottom suspension
- Honeywell Uranium Hexafluoride incident
- Navy take-over of industry/NRC in 1980s
- Failures to act on precursors: Dresden Drywell event.
- Indian Point 1 closure after new ECCS criteria
- Robert Pollard's 60 Minutes interview.
- Y2K requirements for plant computer systems.
- Standard Review Plan

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Rules

- **This is a "Top Ten" list.**
- **This is history--no events after the year 2000.**
- **But . . . no events before 1945.**
- **Focus on U.S. reactor safety regulation.**
- **Events must shape the pattern of U.S. regulation**

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If This Was a Top 20 List

- **Price-Anderson Act (1957)**
- **Linear No-Threshold Model**
- **General Design Criteria**
- **Calvert Cliffs Decision (1971)**
- **Browns Ferry Fire (1975)**
- **Institute of Nuclear Power Operations (1979)**
- **Licensing Delays: Seabrook or Shoreham**
- **Backfit Rule (1988-89)**
- **Safety Culture Events—Chernobyl, Peach Bottom, Millstone, Davis-Besse**

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The Top Ten

- Reactor Safeguard Committee and WASH-3 (1948-49)
- Ike's Atoms for Peace Speech (1953)
- Above-Ground Weapons Testing (1950s-60s)
- Ergen Report (1967)
- Anticipated Transient Without Scram (ATWS) (1969)
- WASH-1400 (1972-75)
- TMI (1979)
- Maintenance Rule (1991)
- Policy Statement on PRA (1995)
- Reactor Oversight Process (ROP) (1999)

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Three Eras and a Turning Point

- 1st Era: The Design Basis: Safety's "Three Ds"
  - DBAs, Defense-in-Depth, and Deterministic Design
    - Reactor Safeguard Committee and WASH-3 (1948-49)
    - Ike's Atoms for Peace Speech (1953)
    - Atmospheric Weapons Testing (1950s-60s)
- Turning Point (1967)
    - Ergen Report

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- 2nd Era: Beyond the Design Basis
  - ATWS (1969)
  - WASH-1400 (1972-75)
  - TMI (1979)
- 3rd Era: Beyond Design—Risk-Informing Operations
  - Maintenance Rule (1991)
  - PRA Policy Statement (1995)
  - Reactor Oversight Process (1999)

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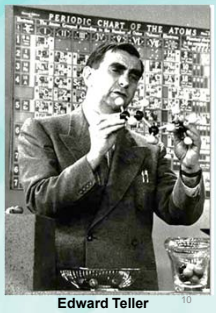
1) Reactor Safeguard Committee

- Maximum Credible Accidents
- Defense-in-Depth
  - Isolation—exclusion zones
  - Inherent Safety
  - Static Layers--Containment
  - Active Safety Systems
- Emergency Planning
- Hazard Reports
- Two-step Approval Process



Edward Teller

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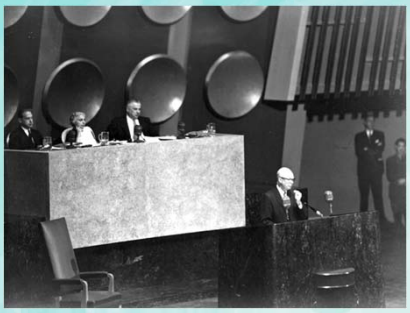
U.S.NRC RIC 2018

2) Dwight Eisenhower's Atoms for Peace Speech, 1953



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U.S.NRC RIC 2018

Atomic Energy Act of 1954

- Unleash the atom by free enterprise
- End Govt. Monopoly and Secrecy
- Ownership of Special Nuclear Material
- International Devel.

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U.S.NRC RIC 2018

- Promote Nuclear Power
  - Information and training
  - Aid for reactors at home and abroad
  - R&D at National Laboratories
  - Financial incentives

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U.S.NRC RIC 2018

- 1950s: Light regulation/promote private innovation
  - Limited oversight of operations, operator licensing, and Special Nuclear Material.
  - Diverse Designs
  - Two-Step Licensing
  - An Outer Boundary: Maximum Credible Accident*
    - Loss of Coolant Accident
  - Defense in Depth

* Later known as Design Basis Accident (DBA)

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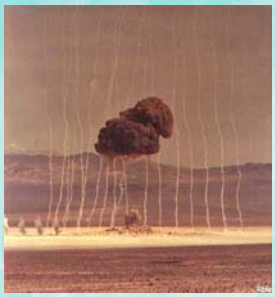
U.S.NRC RIC 2018

3) Above-Ground Testing



Test Able, January 27, 1951, Nevada

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Your children's teeth contain Strontium-90

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U.S.NRC RIC 2018

- Fear of low-level radiation. Dose standards revised
- AEC's reputation
  - Federal Radiation Council
- Spillover to civilian reactors

Test Ban Treaty, October 7, 1963

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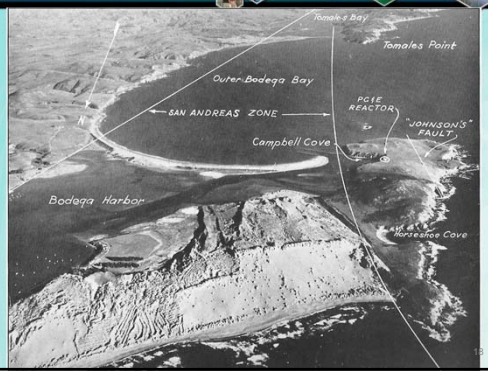

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- **Seismic and Siting Issues**
  - **Basis for public opposition in 1960s**
  - **Established regulatory boundaries**
- **Adequate Protection**
- **Design against stylized DBAs (LOCA, earthquakes, and floods).**
- **Siting—accidents greater than DBAs**
- **Defense in Depth**
- **Containment the last line in defense-in-depth.**

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U.S.NRC RIC 2018

Weaknesses of the 1st Era

- **Limited understanding of severe accident behavior**
- **New accident scenarios outside the DBAs?**
- **Risk of a credible not known**
- **A design-heavy regulatory system**
- **Nuclear fear**

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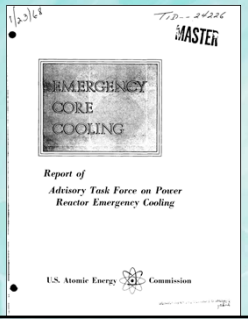
4) Turning Point: The Ergen Report



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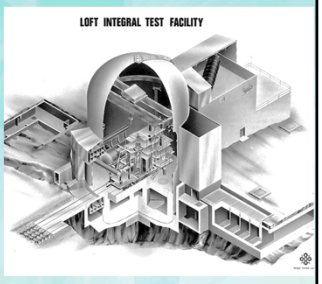
- **The China Syndrome**
- **Ergen Report (1967)**
  - **From mitigation to prevention**
- **ECCS rulemaking (1972-73)**
  - **Criteria**
  - **AEC harassment of staff?**
- **End of AEC**



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U.S.NRC RIC 2018

Defense in Depth

- 1) The prevention of accidents . . . so that the probability of an accident . . . is very small.
- 2) Protective systems [for] corrective action.
- 3) Mitigate the consequences of [accidents]. . . . The ECCS is part of the third line of defense [as was containment].

(ECCS Rulemaking Hearings, 1971-73)

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5) ATWS (1969-1984)

- A probabilistic turn
- Beyond the DBA:
  - Station blackouts, aircraft impact, combustible gas, fire regulations.

Browns Ferry NPP

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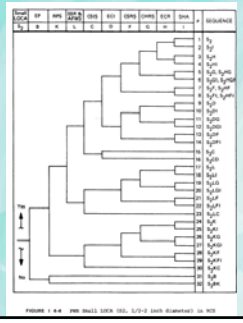
6) WASH-1400



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WASH-1400 Legacies

- Sorting Generic Issues
- Safety Goal Policy Statement (1986)
- NUREG-1150
- Individual Plant Examination assessment
- Changes to licensing basis
- Consequence analysis

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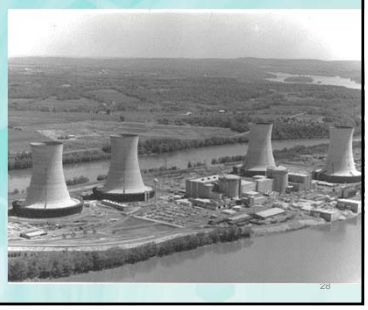
7) Three Mile Island

- Human factors and operations
- Severe accident research
- SBO, auxiliary feedwater
- Emergency planning
- INPO and voluntary industry initiatives.



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"The Commission recognizes the importance of mitigating the consequences of a core-melt accident [with] . . . containment, siting in less populated areas, and emergency planning as integral parts of . . . defense-in-depth . . . [and] its accident prevention and mitigation philosophy."

Safety Goals Policy Statement, August 1986

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Safety in the First Era

- **Adequate protection through DBAs**
  - **DBAs**
  - **Deterministic design**
  - **Defense in Depth**

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Safety in the Second Era

- Adequate protection through DBAs
  - –DBAs
  - –Deterministic design
  - –Defense in Depth: Broadened to include mitigation, emergency planning, human factors, and operations
- "Enhancing" Safety Regulations
  - –"Beyond-design-basis" events (ATWS, station blackout, large fires, aircraft impact).
  - –Self-regulation: NRC-endorsed self-regulation for severe accidents, operations, and training.

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NRC Oversight of Operations

- NRC: Regulating operating reactors after TMI
  - –The Rogovin Report
- The Utility Industry: Ike's legacy of independence
- New Tools
  - – PRA and other codes
    - •NUREG-1150 and Individual Plant Examinations (IPEs)
  - – Improved industry-wide data collection and sharing
  - – INPO and voluntary industry initiatives
  - – Performance-based regulation

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3rd Era: Beyond Design—Risk-Informing Operations

- Maintenance Rule (1991)
- PRA Policy Statement (1995)
- Reactor Oversight Process (1999)

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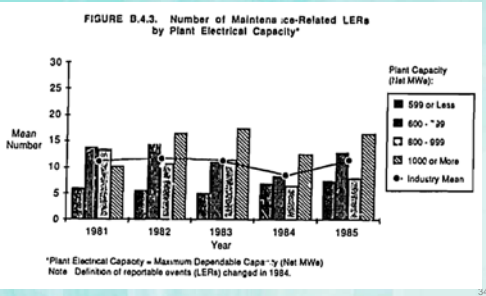
8) Maintenance Rule



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8) Maintenance Rule

- The search for a model (1988)
  - Avoid prescriptive regulation
  - Encourage industry initiative—standard, planning, and effectiveness assessment.
  - No mention of "risk"
- Crafting the rule (1989-91)
  - "Risk-focused" maintenance: PRA and expert panels
  - Safety significance
  - Corrective action plans
- Section a(4): Assessing and managing maintenance risk (1999)

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9) PRA Policy Statement

- From risk-based to risk-informed policy
  - Staff and industry uses of PRA
  - Uncertainties: PRAs, external events, defense-in-depth, and expert judgment
- PRA policy statement: Encouraged PRA as part of "an integrated and comprehensive examination" of safety issues.

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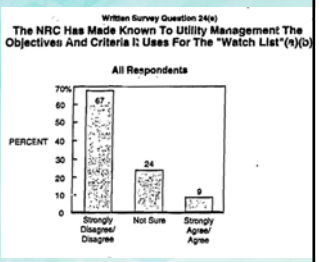
10) Reactor Oversight Process

- Oversight after TMI
  - Resident Inspectors
  - Systematic Assessment of Licensee Performance (SALP)
- Industry view of SALP
  - Arbitrary and opaque
  - Towers Perrin Report (1994): NRC "negative and punitive."



Towers Perrin Report

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10) Reactor Oversight Process

- ROP (1999):
  - –Industry initiative
  - –Risk-informed, performance-based.
  - –Elements:
    - •Cornerstones of Reactor Safety
    - •Performance Indicators
    - •Significance Determination Process
    - •Action Matrix
    - •Corrective Action Program

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Safety Across Three Eras

- Adequate protection through DBAs
  - –DBAs
  - –Deterministic design
  - –Defense in Depth: Broadened to include mitigation, EP, human factors, and operations
- Enhancing Safety Regulations
  - –"Beyond-design-basis" events (ATWS, station blackout, large fires, aircraft impact).
  - –Self-regulation: NRC-endorsed self-regulation for severe accidents, operations, and training.
- Risk-informed, Performance-based

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Acronyms

- ATWS: Anticipated Transient Without Scram
- DBA: Design Basis Accident
- ECCS: Emergency Core Cooling System
- INPO: Institute of Nuclear Power Operations
- IPE: Individual Plant Examination
- LOCA: Loss of Coolant Accident
- PRA: Probabilistic Risk Assessment
- ROP: Reactor Oversight Process
- SALP: Systematic Assessment of Licensee Performance
- SBO: Station Blackout
- TMI: Three Mile Island
- UCS: Union of Concerned Scientists
- WASH: AEC Headquarters, Washington, DC

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